GE Fanuc Automation

Computer Numerical Control Products

AC Spindle Motor Series
(Serial Interface)

Descriptions Manual
(Volume 3 of 4)

GFZ–65042E/05

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Warnings, Cautions, and Notes as Used in this Publication

Warning

Warning notices are used in this publication to emphasize that hazardous voltages, currents, temperatures, or other conditions that could cause personal injury exist in this equipment or may be associated with its use.

In situations where inattention could cause either personal injury or damage to equipment, a Warning notice is used.

Caution

Caution notices are used where equipment might be damaged if care is not taken.

Note

Notes merely call attention to information that is especially significant to understanding and operating the equipment.

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CONSTITUTION OF THIS MANUAL

This manual (B-65042E) is composed of the following 4 volumes.

Vol. 1

I. AC SPINDLE MOTOR S series

GENERAL/ FEATURES/ SPECIFICATIONS/ OUTPUT AND TORQUE CHARACTERISTICS/
CONFIGURATION AND ORDER DRAWING NUMBER/ CONNECTIONS/
ALLOWABLE RADIAL LOAD/ ASSEMBLING ACCURACY/ EXTERNAL DIMENSIONS

II. AC SPINDLE MOTOR P series

GENERAL/ FEATURES/ SPECIFICATIONS/ OUTPUT AND TORQUE CHARACTERISTICS/
ORDER DRAWING NUMBER/ CONNECTIONS/ ALLOWABLE RADIAL LOAD/
ASSEMBLING ACCURACY/ EXTERNAL DIMENSIONS

III. AC SPINDLE MOTOR VH series (LIQUID-COOLED)

GENERAL/ FEATURES/ SPECIFICATIONS/
OUTPUT AND TORQUE CHARACTERISTICS/ ORDER SPECIFICATIONS/
CAUTIONS IN USE/ ASSEMBLING ACCURACY/ EXTERNAL DIMENSIONS

IV. AC SPINDLE MOTOR HV series (380/415 VAC INPUT)

GENERAL/ FEATURES/ SPECIFICATIONS/ OUTPUT AND TORQUE CHARACTERISTICS/
CONFIGURATION AND ORDER SPECIFICATIONS/ CONNECTION/
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V. LIQUID-COOLED AC SPINDLE MOTOR series

NON HOLLOW SHAFT AND WITHOUT SPEED RANGE SWITCHING TYPE/
OUTLINE/ FEATURES/ SPECIFICATIONS/
CONFIGURATION AND ORDER DRAWING NUMBER/ CONNECTIONS/ CAUTIONS IN USE/
OUTLINE DRAWING OF MOTOR/
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OUTLINE/ FEATURES/ SPECIFICATION/
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Ⅵ. IP65 series

FEATURES/ SPECIFICATIONS/ CHARACTERISTIC/ EXTERNAL DIMENSIONS/
LOAD METER/ ORDER SPECIFICATION DWG NO.

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Ⅶ. AC SPINDLE SERVO UNIT SERIAL INTERFACE S series

GENERAL/ FEATURES/ CONFIGURATION AND DRAWING NUMBER/
SPECIFICATIONS AND FUNCTIONS/ INSTALLATION/ UNIT CALORIFIC VALUE/
COOLING/ EXTERNAL DIMENSIONS AND MAINTENANCE AREA/ CONNECTION/
INTERFACE SIGNALS

Ⅷ. AC SPINDLE SERVO UNIT HV series

GENERAL/ FEATURES/ SPECIFICATIONS/ CONFIGURATION AND ORDER SPECIFICATIONS/
INSTALLATION/ OLING/ EXTERNAL DIMENSIONS AND SERVICE CLEARANCE/
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Ⅸ. POSITION CODER METHOD SPINDLE ORIENTATION

GENERAL/ FEATURES/ CONFIGURATION AND ORDER DRAWING NUMBER/ SPECIFICATIONS/
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X. MAGNETIC SENSOR METHOD SPINDLE ORIENTATION

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SPECIFICATION OF POSITION CODER SIGNAL INPUT CIRCUIT/
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CABLE SPECIFICATIONS/ TECHNICAL DATA/ SERIAL SPINDLE START-UP PROCEDURE/
METHOD FOR OPERATIING THE SPINDLE MOTOR USING A SERIAL SPINDLE AMPLIFIER INSTEAD OF THE CNC/
MONITORING INTERNAL DATA OF THE SERIAL SPINDLE/ GROUNDING/ CUSTOMER RECORDS

PREFACE

The models covered by this manual, and their abbreviations are:

Series name	Model name
FANUC AC SPINDLE MOTOR S series	0.5S, 1S, 1.5S, 2S, 3S, 6S, 8S, 12S, 15S, 18S, 22S, 30S, 40S
FANUC AC SPINDLE MOTOR Power up series	8P, 10P, 12P, 15P, 16P, 18P, 22P, 30P, 40P, 50P, 60P
FANUC AC SPINDLE MOTOR High-speed series	6VH, 8VH, 12VH
FANUC AC SPINDLE MOTOR 380/415V series	30HV, 40HV, 60HV
FANUC AC SPINDLE MOTOR LTQUID-COOLED series	· Non hollow shaft/without speed range switching type L6/12000, L12/6000, L15/6000, L18/6000, L22/6000
	· Hollow shaft/with speed range switching type L12/10000, L15/10000, L22/10000, L26/10000, L40/8000, L50/8000
FANUC AC SPINDLE MOTOR IP65 series	1S, 1.5S, 2S, 3S

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I. AC SPINDLE MOTOR S series

VIII. AC SPINDLE SERVO UNIT HV series

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XIII. HIGH RESOLUTION MAGNETIC PULSE CODER

XVII. SWITCHING UNIT

XVIII. DIFFERENTIAL SPEED CONTROL FUNCTION DESCRIPTION

XI. SPINDLE ORIENTATION WITH 1-REVOLUTION SIGNAL SWITCH

1. GENERAL

This manual describes the spindle orientation function in the system using the reference point signal switch attached to the spindle, and the motor with the built-in sensor which is geared to the spindle with the arbitrary ratio.
This function is almost the same as the conventional position coder method orientation except the followings.

(1) The orientation direction must to be always fixed to one direction.
(The parameter 6503#3 must be set to "1".)

(2) The reference signal is detected after the motor reaches to the orientation speed.

Except the contents about the external reference signal handling, please refer to FANUC AC SPINDLE MOTOR Series (SERIAL INTERFACE) DESCRIPTIONS (B-65042E/04, chapter Ⅷ "POSITION CODER METHOD SPINDLE ORIENTATION" and chapter Ⅹ "BUILT-IN SENSOR SIGNAL CONVERSION CIRCUIT".)

Order specification

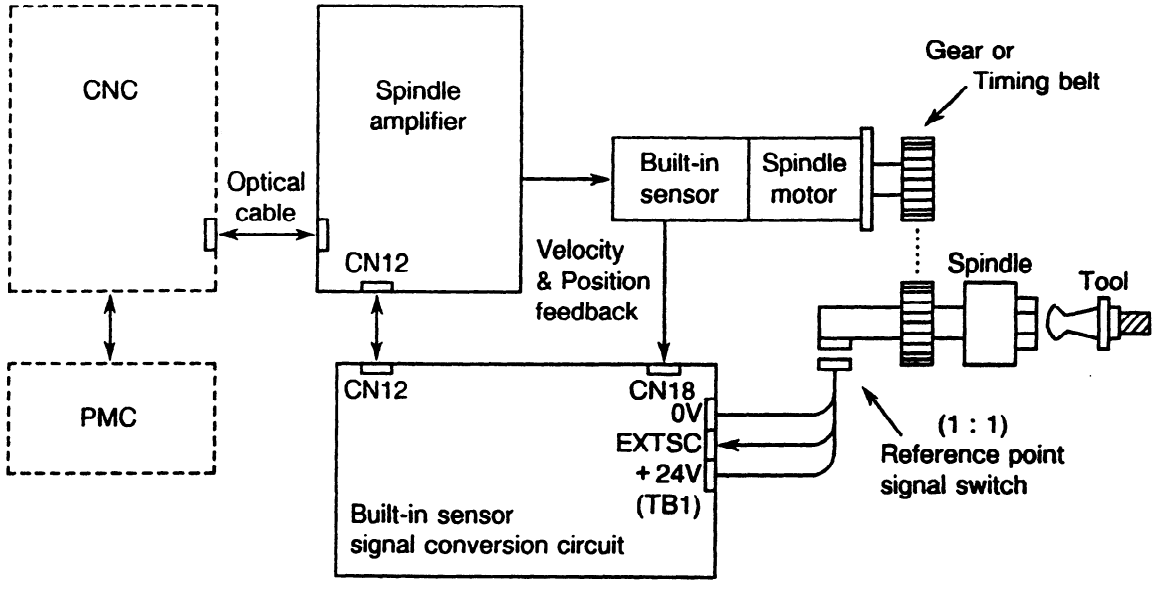
Group	Name	Specification No.	P.C.B. Spec. No.
Option	Unit mount type built-in sensor signal conversion circuit with reference switch	A06B-6064-J707	A16B-2300-0060

This function will be available with the following Serial interface spindle servo unit.

Spindle servo unit	A06B-6064-H3XX#H550
P.C.B.	A16B-2201-0440
P.C.B. Edition No.	03B or later (Note)
ROM	9A50 version Ⅰ or later

(Note) When P.C.B. edition number 01A and 02A, modify spec R908 is need.

2. SYSTEM CONFIGURATION



3. SPECIFICATIONS

(1) Repositioning accuracy

In case of spindle combined motor in optional gear ratio. Repositioning accuracy is following formula.

$$\frac{1024}{\text{Number of output pulse/one rotation of motor}} \times \frac{m}{n} = x$$

(But x raise to fraction of under a decimal point, and x become integral number.)

Repositioning accuracy = $\pm(x \times 0.2)$ [°]

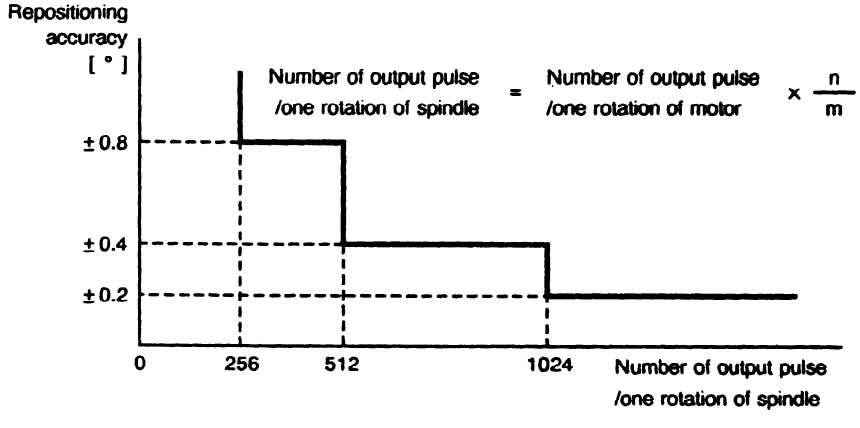
(Reference data)

No. of detection gear teeth /one rotation of motor	Number of output pulse /one rotation of motor
512	1024
256	
128	512
64	

(Note 1) But influence except for machine and reference switch.

(Note 2) Please surrounding temperature take into consideration, when reference switch selection. Because signal generation point of reference switch change for temperature.

(Reference)



Examples of calculation)

(1) Number of output pulse/one rotation of motor = 1024
Gear ratio of spindle to motor (m : n) = 1 : 3 (reduce the speed)

$$x = \frac{1024}{1024} \times \frac{1}{3} = 0.3$$

$$\therefore\ x = 1$$

Repositioning accuracy = ± (1 × 0.2)
= ± 0.2°

(2) Number of output pulse/one rotation of motor = 512
Gear ratio of spindle to motor (m : n) = 2 : 1 (increase the speed)

$$x = \frac{1024}{512} \times \frac{2}{1} = 4$$

$$\therefore\ x = 4$$

Repositioning accuracy = ± (4 × 0.2)
= ± 0.8°

(3) Number of output pulse/one rotation of motor = 512
Gear ratio of spindle to motor (m : n) = 1 : 2 (reduce the speed)

$$x = \frac{1024}{512} \times \frac{1}{2} = 1$$

$$\therefore\ x = 1$$

Repositioning accuracy = ± (1 × 0.2)
= ± 0.2°

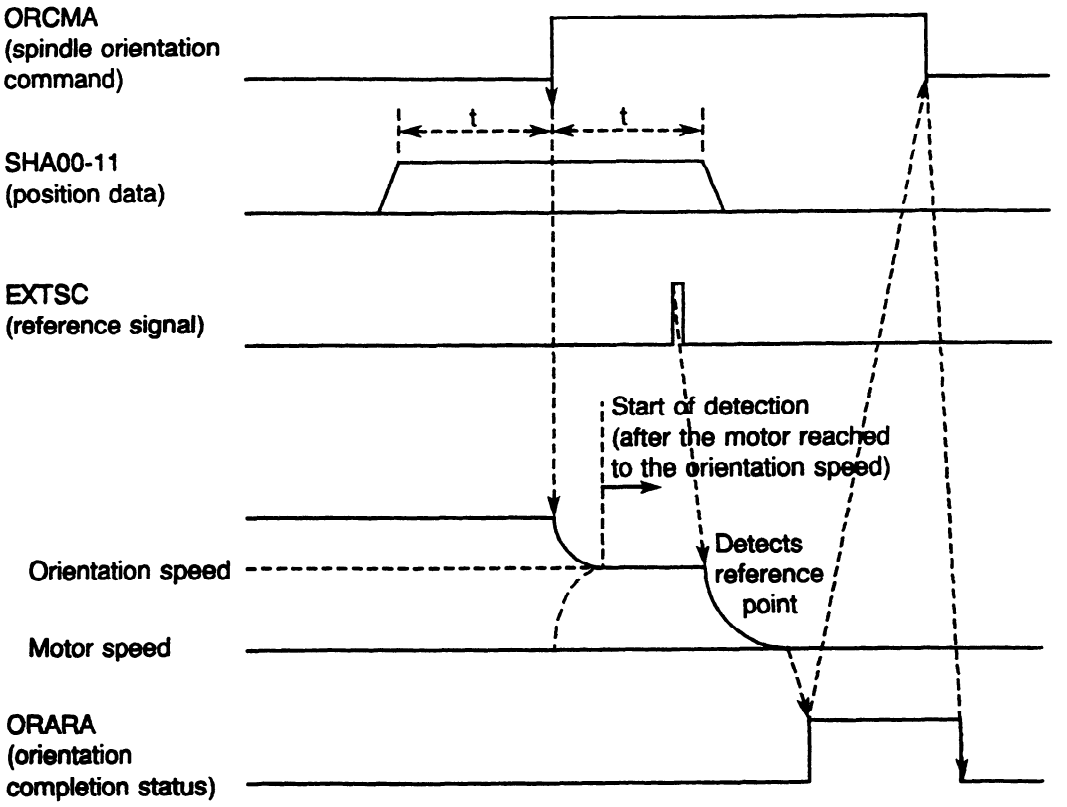
(4) Number of output pulse/one rotation of motor = 512
Gear ratio of spindle to motor (m : n) = 1 : 1 (same the speed)

$$x = \frac{1024}{512} \times \frac{1}{1} = 2$$

$$\therefore\ x = 1$$

Repositioning accuracy = ± (2 × 0.2)
= ± 0.4°

4. CONTROL SEQUENCE



(Note) t (signal keep time) is necessary more than 50 msec because of signal fix.

(1) Positioning ① (Normal orientation motion)

- Please fixes the orientation direction of spindle motor by the parameter.
  (No.6503#3 = "1" : refer to chapter of Setting parameter)

- The spindle starts to rotate toward the fixed direction at the fixed speed (orientation speed) and detects reference point. The spindle stops at the point according to the position data.

  In case of the parameter 80#2 = "0", the positioning data is (No.6531 + No.6577)
  in case of the parameter 80#2 = "1", the positioning data is (SHA00-11 + No.6577)

- The resolution of the spindle orientation is 1/4096 rev (4096 p/rev).

- When the position data [(No.6513 + No.6577) or (SHA00-11 + No.6577)] is "0", the spindle stops at the reference signal edge.

5. PMC SIGNAL (DI/DO SIGNAL)

In this chapter, describes meaning of using PMC signal (DI/DO signal).

(1) PMC → CNC (DO signal)

	(PC address) 0C	15	16	b7	b6	b5	b4	b3	b2	b1	b0
No.1	G110	G231	G078	SHA07	SHA06	SHA05	SHA04	SHA03	SHA02	SHA01	SHA00
No.2	G112	G239	G080								
No.1	G111	G230	G079					SHA11	SHA10	SHA09	SHA08
No.2	G113	G238	G081								

- SHA00-11 (Positioning data)
  These signals are valid in case of the stop position external setting type spindle orientation function.
  These 12-bits signal is the command of positioning data.
  This command is read at rising-edge (0→1) of "ORCMA".
  Power Mate have not this function.

	PM	(PC address) 0C	15	16	b7	b6	b5	b4	b3	b2	b1	b0
No.1	G112	G229	G227	G070		ORCMA			CTH1A	CTH2A		
No.2		G233	G235	G074								

- ORCMA (Spindle orient-command)
  1 : Execute the spindle orientation

- CTH1A, CTH2A (Gear/Clutch selector)
  The spindle parameters (Position gain, Velocity loop gain, Gear ratio, etc.) are selected by these two signals.

CTH1A	CTH2A	Gear/Clutch select status	
0	0	High Gear	(High)
0	1	Medium High Gear	(High)
1	0	Medium Low Gear	(Low)
1	1	Low	(Low)

(2) PMC ← CNC (DI signal)

	(PC address) PM	0C	15	16	b7	b6	b5	b4	b3	b2	b1	b0
No.1	F228	F281	F229	F045	ORARA							
No.2		F285	F245	F049								

- ORARA (Orient-completion status)
  Indicates orientation completion status. This signal is set to "1" when satisfies following 3 terms.

  a. Spindle orientation command (ORCMA) is set to "1".
  b. Speed zero signal (SSTA) is set to "1".
  c. The spindle position is within the parameter setting level (No.6575).

6. PARAMETERS

(Parameter No.)

	PM	0C	15	16	b7	b6	b5	b4	b3	b2	b1	b0
No.1	3003	6503	3003	4003					DIRCT2	DIRCT1		PCMGSL
No.2		6643	3143									

PCMGSL : Select the position coder/magnetic sensor spindle orientation.
- 0 : Position coder method spindle orientation.
- 1 : Magnetic sensor method spindle orientation.

DIRCT2, 1 : Direction of rotation at the spindle orientation.
- 0 0: The direction that the spindle was turning just before the orientation command was given (Initial CCW)
- 0 1: The direction that the spindle was turning just before the orientation command was given (Initial CW)
- 1 0: CCW (counter-clockwise)
- 1 1: CW (clockwise)

(Note) This parameter must be set to "10 (CCW)" or "11 (CW)".

(Parameter No.)

	PM	0C	15	16	b7	b6	b5	b4	b3	b2	b1	b0
No.1	3009	6509	3009	4009					PCGEAR			
No.2		6649	3149									

PCGEAR : Usage Spindle Orientation Function with Reference Switch

(Note) This parameter bit must be set to "1 (used)", and PRM6935-6938 must be set too.

(Parameter No.)

	PM	0C	15	16	b7	b6	b5	b4	b3	b2	b1	b0
No.1	3013	6513	3013	4013								ESEC
No.2		6653	3153									

ESEC : Reference signal detecting edge at the spindle orientation

(Note) This parameter bit must be set to "1 (CCW, CW = rizing edge)".

(Parameter No.)

	PM	0C	15	16	b7	b6	b5	b4	b3	b2	b1	b0
No.1	3015	6515	3015	4015								ORIENT
No.2		6655	3155									

ORIENT : Usage of the spindle orientation function. (The CNC software option is necessary)
- 0 : Not used
- 1 : Used

(Parameter No.)	PM	0C	15	16	
No.1	3038	6538	3038	4038	Spindle orientation speed (speed of spindle)
No.2		6678	3178		

Data unit : 1 min^{-1} (When parameter SPDUNT (No.6506#2) = 110 min^{-1})
Data range : 0 to 32767 (Standard setting: 0)

In case of the gear ratio change.
Spindle orientation speed is fixed this parameter for reference signal stable detection.

(Note) This parameter is valid in case of usage spindle orientation function with reference switch.

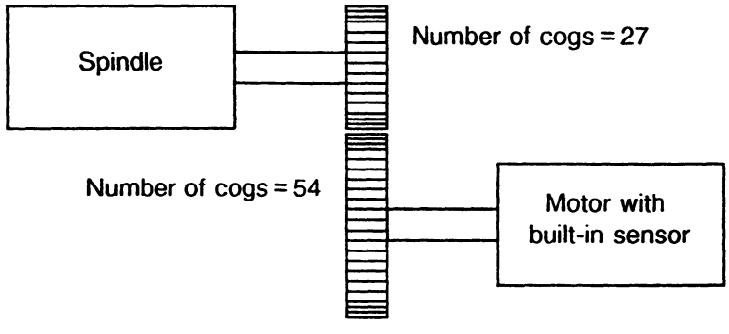
(Parameter No.)	PM	0C	15	16		
No.1	3171	6935	3315	4171	The number of cogs on spindle gearwheel (High)	CTH1A = 0
No.2		6975	3535			
No.1	3172	6936	3316	4172	The number of cogs on detector gearwheel (High)	
No.2		6976	3536			
No.1	3173	6937	3317	4173	The number of cogs on spindle gearwheel (Low)	CTH1A = 1
No.2		6977	3537			
No.1	3174	6938	3318	4174	The number of cogs on detector gearwheel (Low)	
No.2		6978	3538			

Data range : 0 to 32767 (Standard setting: 0)

The gear ratio between the position-detector and the spindle are specified by these parameters.
These parameters are enabled by setting No.6509#3 = "1 (enable Spindle Orientation Function with Reference Switch)".
If these parameters are "0" in case of No.6509#3 = 1, these parameter data are automatically treated as "1".

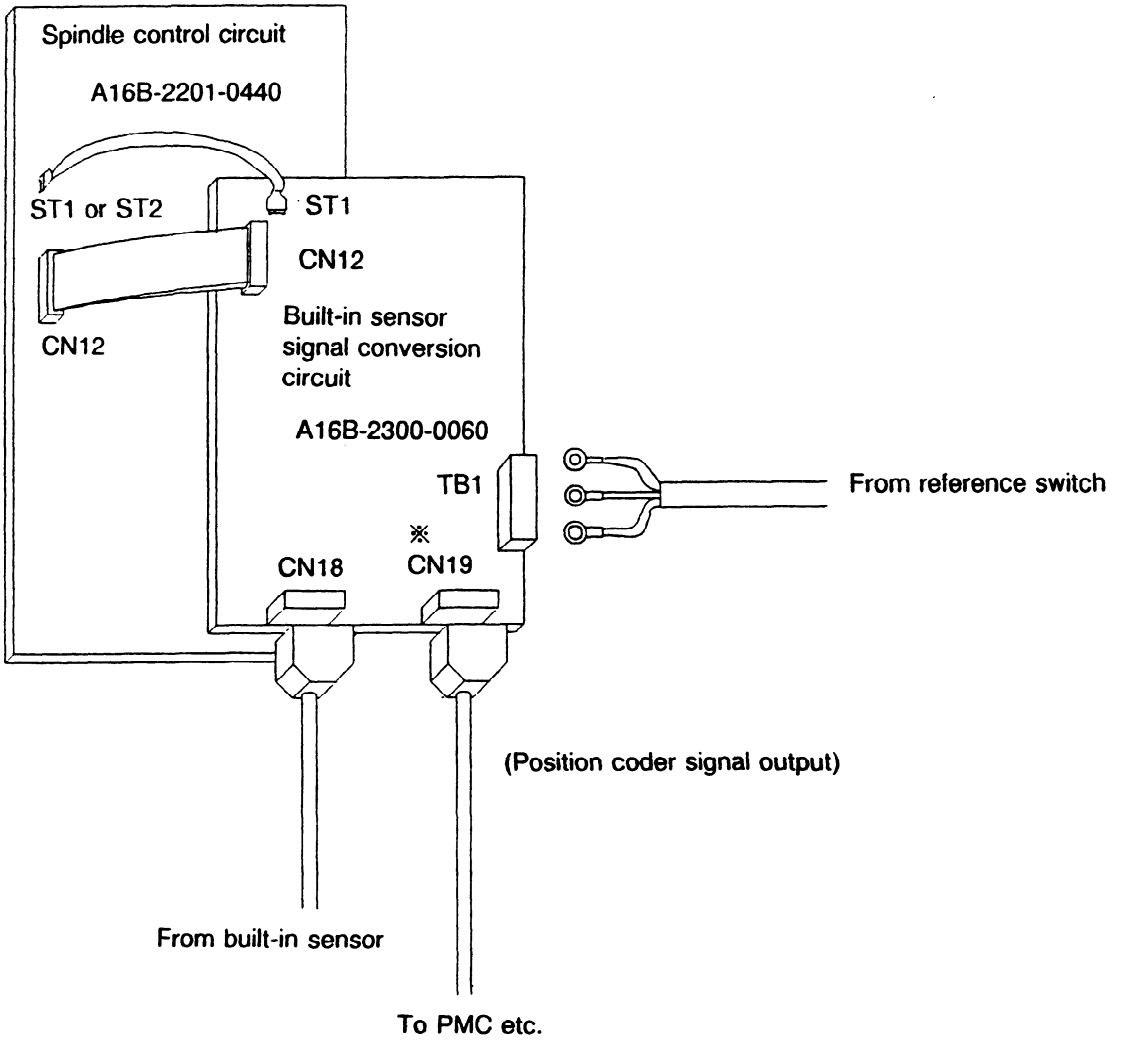
(Example) The number of cogs spindle gearwheel = 27
The number of cogs motor (with built-in sensor) gearwheel = 54

Set to No.6935 = 27 and No.6936 = 54



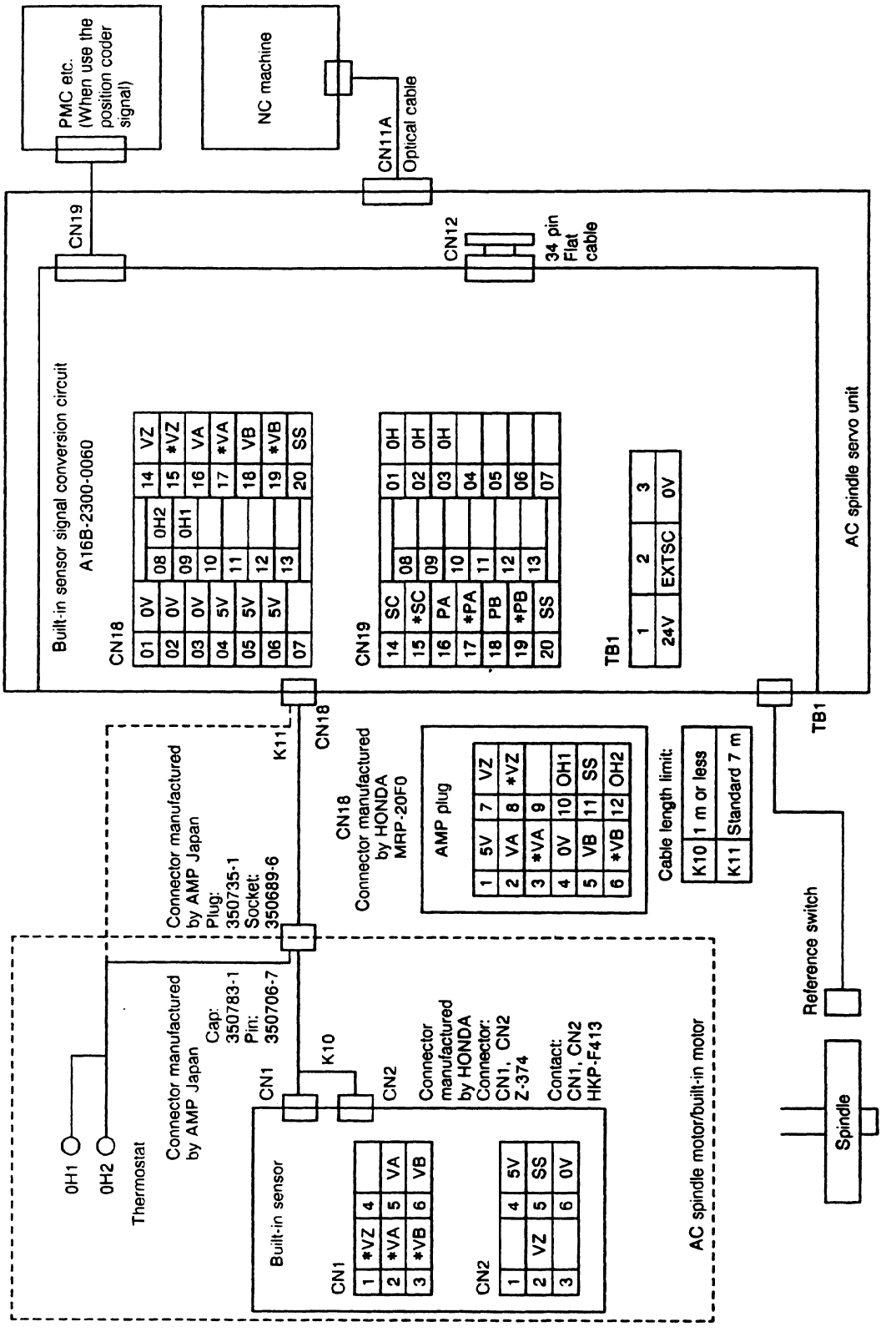
7. CABLE CONNECTION

7.1 Connection Diagram

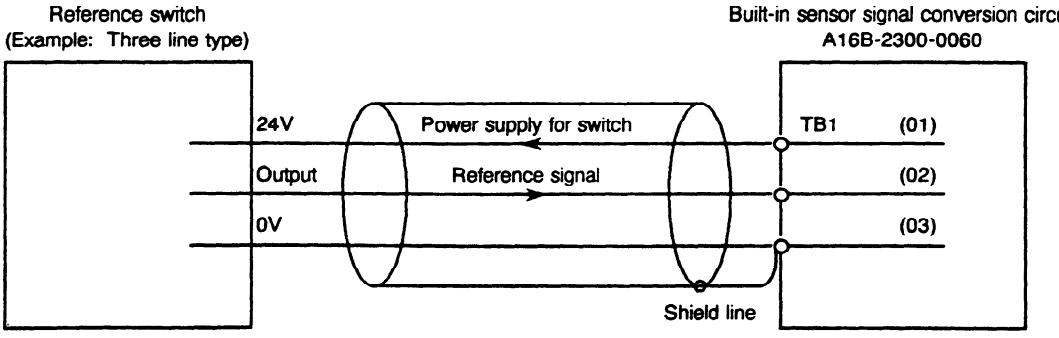


※ When you use the position coder signal with PMC, etc., please take out the position coder signal of CN19.

7.2 Pin Assignment of Each Cable



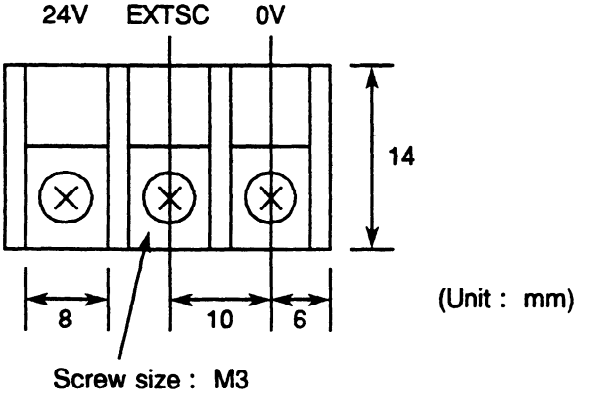
7.3 Details of TB1 (For External Reference Switch)



(Note 1) Use the shielding cable and connect shielding cable to TB1 (0V).

(Note 2) Keep the distance from the motor power line for avoiding the switching noise.

Terminal Dimension (TB1)



8. SPECIFICATIONS OF REFERENCE SWITCH

Please use the reference switch which meets the following specifications for this signal conversion circuit.

Item	Specifications
Power supply voltage	DC 21 to 24 V allowable ripple 0.5% or more (p-p) (DC 24 V is supplied by the spindle amplifier)
Response frequency	Min. 400 Hz
Load current	Min. 7.3 mA
Consumption current	Max. 50 mA
Reference signal wave form	Please refer to '9. Setting pins (SH8 to 10)'

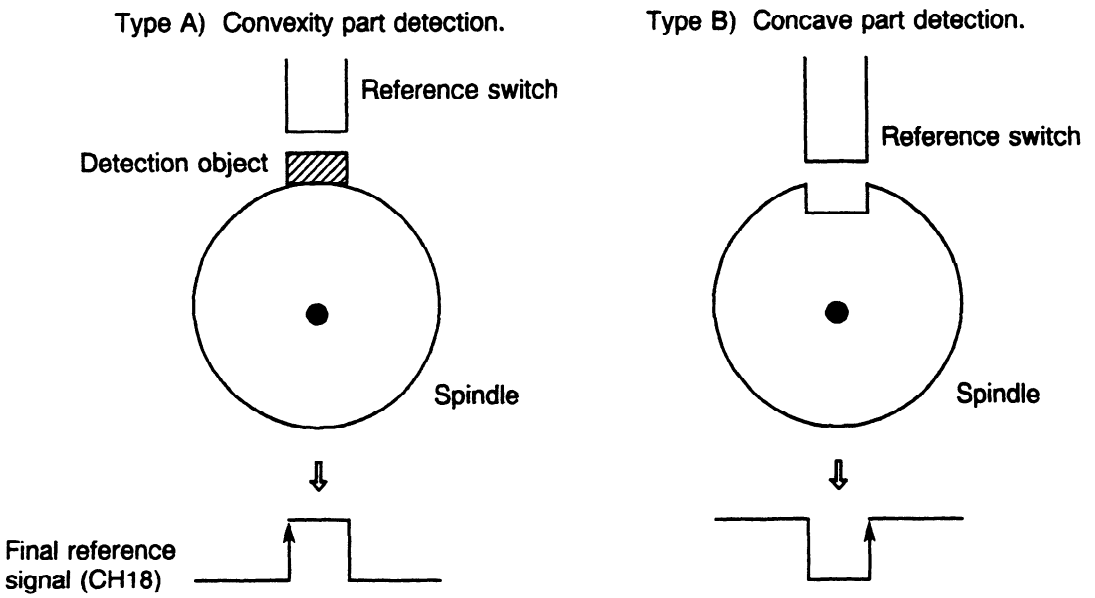
9. SETTING PINS (SH8 TO 10)

9.1 SH8 (Selection of Reference Signal)

Pin No.	Content	Setting	Setting
SH8	Selection of reference signal	A : Reference signal of a built-in sensor is used	B
		B : Reference signal of the reference switch is used	

9.2 SH9, 10 (Selection of Reference Signal Edge)

SH9, 10 are the setting for deciding the detecting edge of the reference signal.
There are two type of the detecting methods.



The final refcrence signal (CH18) is different according to the detecting method.
The original reference signal (EXTSC) is varying according to the reference switch type (Normal open or Normal close, and NPN transistor to PNP transistor output) shown as table 1 and 2.
SH9, 10 are for converting the reference signal from the original reference signal (EXTSC) to the final reference signal (CH18).
About the setting, please refer to table 1 and 2.

Table 1) Convexity part detection.

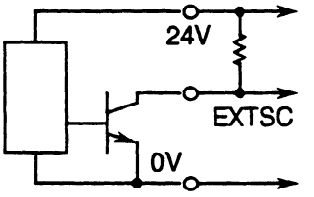
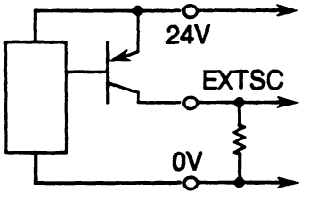
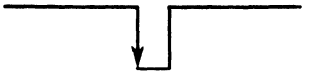
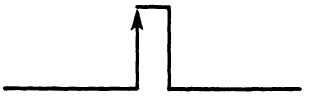
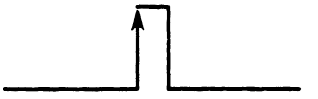
	Normal open	
	NPN	PNP
TYPE		
EXTSC		
CH18 (SC)		
SH9	B	A
SH10	B	A

Table 1) Convexity part detection. (continue)

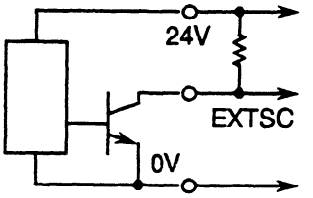
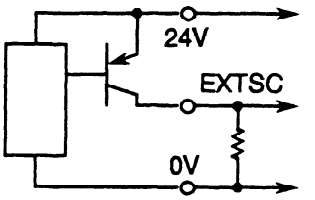
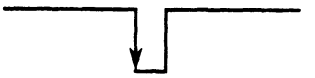
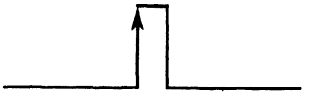
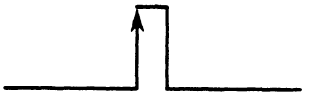
	Normal close	
	NPN	PNP
TYPE		
EXTSC		
CH18 (SC)		
SH9	B	A
SH10	A	B

Table 2) Concave part detection.

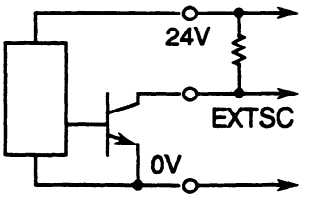
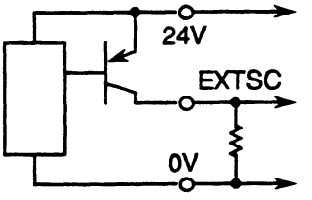
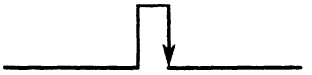
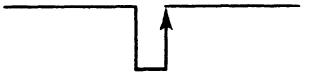
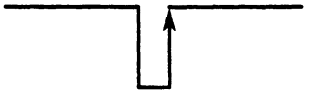
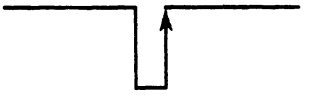
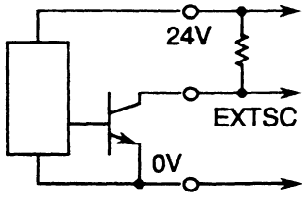
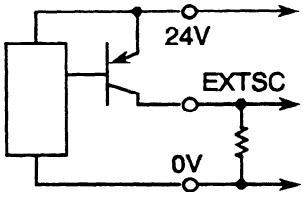
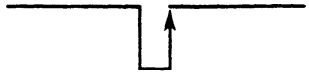
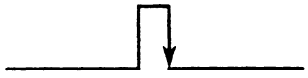
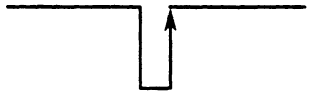
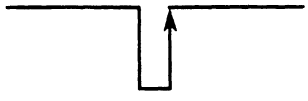
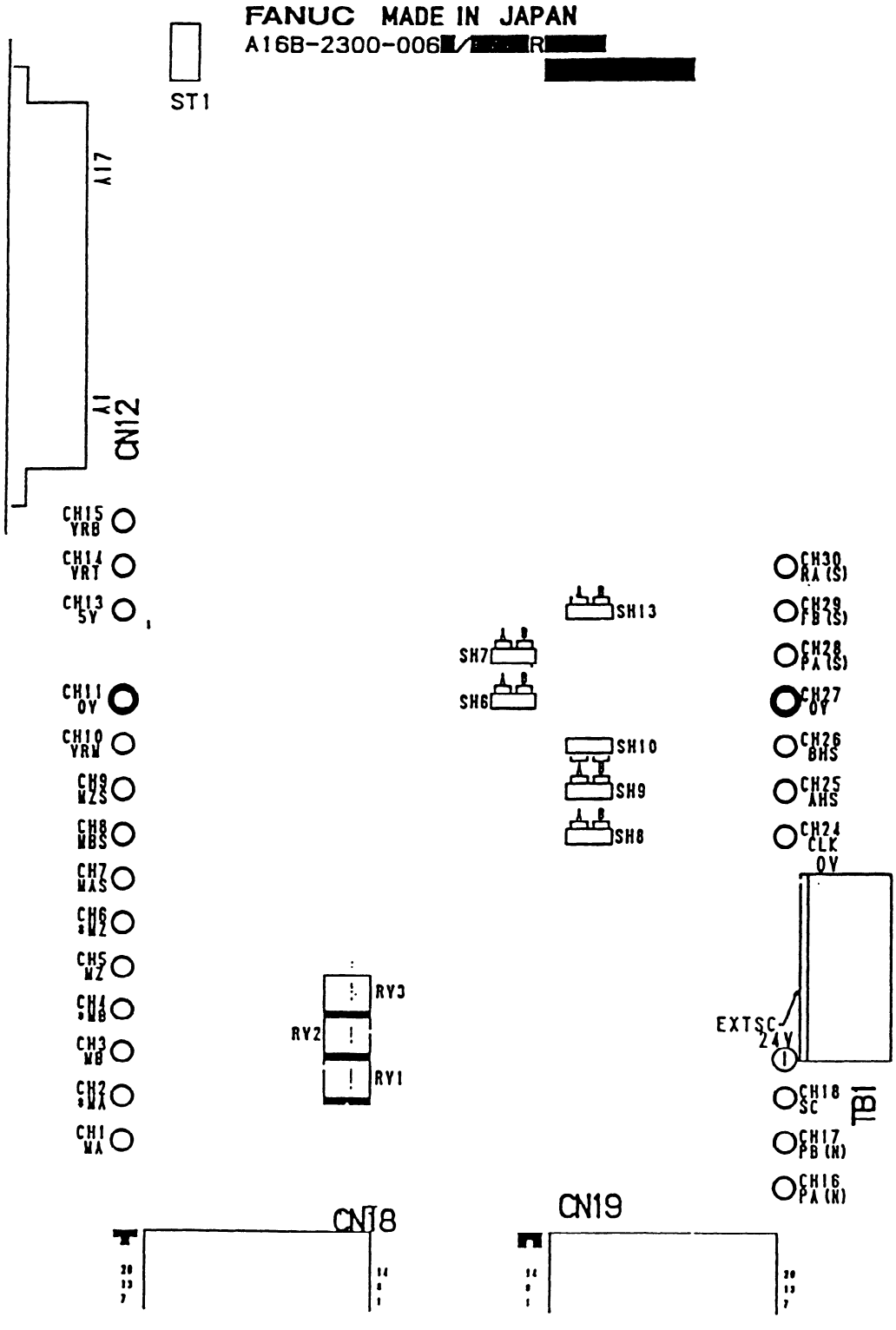
	Normal open	
	NPN	PNP
TYPE		
EXTSC		
CH18 (SC)		
SH9	B	A
SH10	B	A

Table 2) Concave part detection. (continue)

	Normal close	
	NPN	PNP
TYPE		
EXTSC		
CH18 (SC)		
SH9	B	A
SH10	A	B

10. MOUNTING DIAGRAM OF SETTING PINS, CHECK PINS AND VARIABLE RESISTORS



11. NOTES

(1) When power supply is turned on, please set the spindle orientation command "ORCMA" to 0.

(2) If starting the spindle orientation, for safety, please set the spindle forward/reverse command "SFRA/SRVA" to 0, and the speed command to 0.

(3) If there is an emergency stop during the spindle orientation, the spindle orientation command "ORCMA" must be reset to 0.

(4) The fluctuation of the reference signal edge influences the positioning repeatability. Please use the reference switch with the stable edge signal.

(5) Please surrounding temperature take into consideration, when reference switch selection. Because signal generation point of reference switch change for temperature.

XII. BUILT-IN SENSOR SIGNAL CONVERSION CIRCUIT

1. GENERAL

This part describes a signal conversion circuit. The signal conversion circuit receives a signal from a built-in sensor used with a built-in motor or AC spindle motor with a built-in sensor used for NC machine tools. Then the signal conversion circuit outputs a speed detection signal and position coder signal.

2. FEATURES

(1) With a built-in sensor and the signal conversion circuit, a motor speed feedback signal and spindle position coder signal can be obtained.
(2) The AC spindle motor with a built-in sensor has the same outside dimensions as the standard series.
(3) A function has been added which checks the detection signal level and raises an alarm (disconnection detected) if an abnormality occurs.
(4) The signal conversion circuits for the AC spindle motor model 0.5S (with a green label) having the following specification drawing numbers have been added: A06B-6063-H731 and A06B-6064-J706. For the signal conversion circuits, see Note 1).

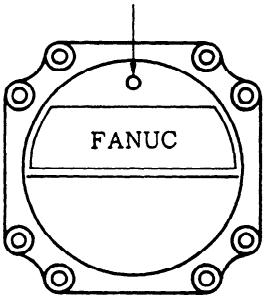
(Note 1) The signal conversion circuits can be used only for the following 0.5S motors and IP65 series (1S - 3S motor):

① 0.5S motors delivered on or after December, 1991
Motor specification drawing number:
A06B-0776-B390 and A06B-0776-B490 (with green labels)
The green labels were attached only to the motors delivered from December, 1991 to April, 1992.

② A green label is attached to the rear of the motor to identify it. See the figure on the right.
The output amplitude of the built-in sensor for the motor is different from that for a general motor.

③ The signal conversion circuits for every motor must be adjusted and checked.

Location of the green label



Rear of the motor

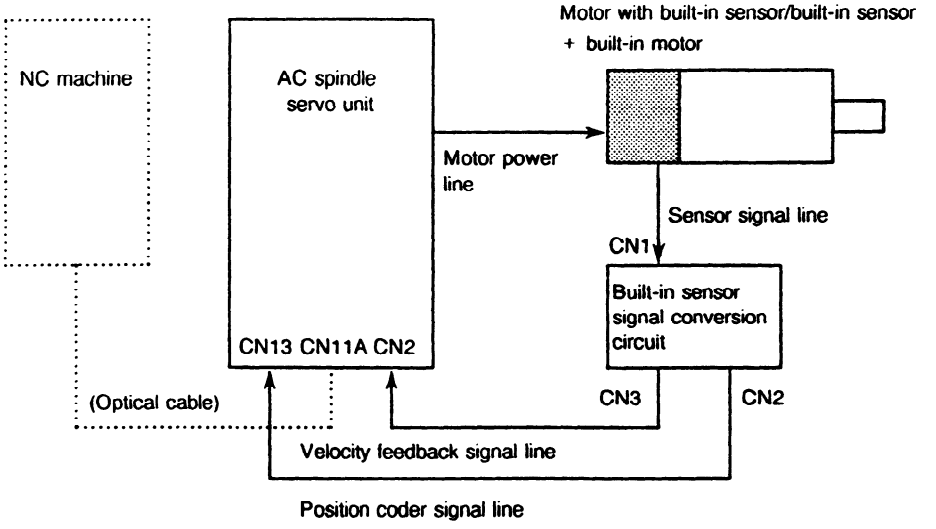
(5) The following built-in signal conversion circuit is available.
Specification drawing number: A06B-6064-J704
The built-in signal conversion circuit can only be used for the specified spindle amplifiers. See Section 3.2.2, "Amplifiers for which the built-in signal conversion circuit can be used."
The following optional circuits cannot be used together with the built-in signal conversion circuit.

Optional circuit unusable with built-in signal conversion circuit	
Name	Specification drawing number
Spindle switching control circuit	A06B-6064-J701 A06B-6064-J702
Position coder signal input circuit	A06B-6064-J703
Detection circuit for a high-resolution position coder	A06B-6064-J705
Detection circuit for a high-resolution magnetic pulse coder	A06B-6064-J720 A06B-6064-J721 A06B-6064-J722 A06B-6064-J724 A06B-6064-J725 A06B-6064-J726

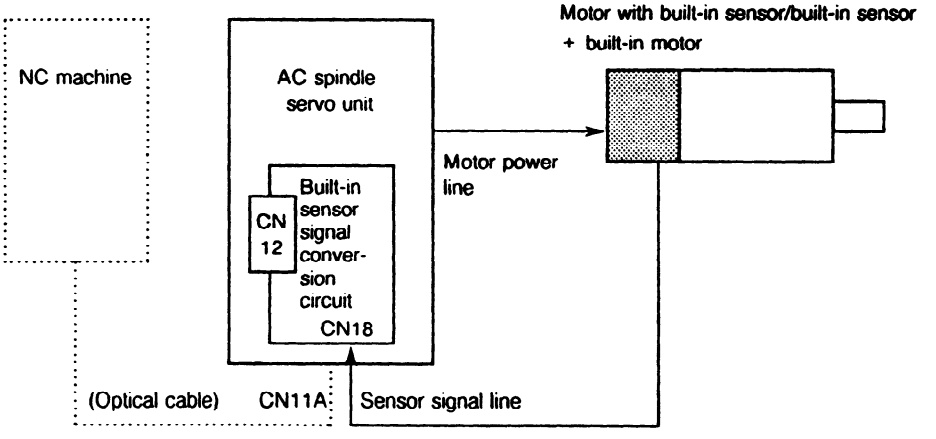
3. CONFIGURATION

3.1 Example of Configuration

3.1.1 Separate signal conversion circuit



3.1.2 Signal conversion circuit mounted in the unit



3.2 Order Drawing Numbers

3.2.1 Signal conversion circuits

Classification	Name	Specification drawing number	PC board drawing number	Remarks
Option	Separate signal conversion circuit	A06B-6063-H730	A16B-1600-0440	The three types, A06B-6044-H603, A06B-6044-H605, and A06B-6044-H606, have been changed to this type.
		A06B-6063-H731 (*1)	A16B-1600-0441 (*1)	For the 0.5S and IP65 series (1S - 3S) motor with a green label (*1)
	Built-in signal conversion circuit	A06B-6064-J704	A16B-1300-0220	
		A06B-6064-J706 (*1)	A16B-1300-0221 (*1)	For the 0.5S and IP65 series (1S - 3S) motor with a green label (*1)

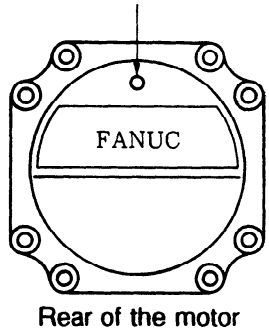
(*1) The signal conversion circuit can be used only for the following 0.5S motors.

① 0.5S motors delivered on or after December, 1991
Motor specification drawing number:
A06B-0776-B390 and A06B-0776-B490 (with green labels)
The green labels were attached only to the motors delivered from December, 1991 to April, 1992.

② A green label is attached to the rear of the motor to identify it. See the figure on the right.
The output amplitude of the built-in sensor for the motor is different from that for a general motor.

③ The signal conversion circuits for every motor must be adjusted and checked.

Location of the green label



Rear of the motor

3.2.2 Amplifiers for which the built-in signal conversion circuit can be used

Name	Specification drawing number
Spindle control unit model 1S	A06B-6064-H301#H550
Spindle control unit model 2S	A06B-6064-H302#H550
Spindle control unit model 3S	A06B-6064-H303#H550
Spindle control unit small model 6S	A06B-6064-H305#H550
Spindle control unit model 6S	A06B-6064-H306#H550
Spindle control unit model 8S	A06B-6064-H308#H550
Spindle control unit model 12S	A06B-6064-H312#H550
Spindle control unit small model 15S	A06B-6064-H313#H550
Spindle control unit model 15S	A06B-6064-H315#H550
Spindle control unit model 18S	A06B-6064-H318#H550
Spindle control unit model 22S	A06B-6064-H322#H550
Spindle control unit model 26S	A06B-6064-H326#H550
Spindle control unit small model 30S	A06B-6064-H327#H550
Spindle control unit model 30HV	A06B-6065-H030#H550
Spindle control unit model 40HV	A06B-6065-H040#H550
Spindle control unit model 60HV	A06B-6065-H060#H550

4. SPECIFICATIONS

This specification is not guaranteed if the signal conversion circuit is not adjusted and set correctly. For details, see the maintenance manual (B-65045E).

4.1 Compatibility with Conventional Specifications (Compatibility Provided by Setting Pins SH6 and SH7)

Conventional specification number (PC board drawing number)	⇒	new specification number (setting position)	Remarks
A06B-6044-H603 (A20B-9000-0180)	⇒	A06B-6063-H730 (SH6: B, SH7: A) A06B-6064-H704 (SH6: B, SH7: A)	For details, see Subsection 4.2.1.
A06B-6044-H605 (A16B-1600-0370)	⇒	A06B-6063-H730 (SH6: B, SH7: A) A06B-6064-H704 (SH6: B, SH7: A)	
A06B-6044-H606 (A16B-1600-0390)	⇒	A06B-6063-H730 (SH6: A, SH7: A) A06B-6064-H704 (SH6: A, SH7: A)	

(Note) When the built-in signal conversion circuit is used, the built-in sensor cannot be used only for position control loop in place of the position coder. Use the separate type signal conversion circuit when the built-in sensor is used only for position control loop.

4.2 Position Coder Output Signal

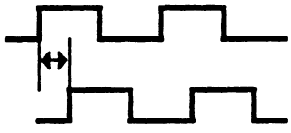
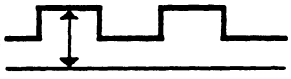
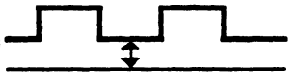
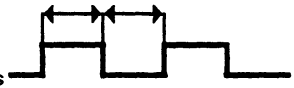
4.2.1 Number of detector pulses and number of position coder signal output pulses

	Number of detector pulses per revolution	Interpolation multiplier	SH 6	SH 7	Number of position coder signal output pulses per revolution	Remarks
Phase A Phase B	512 pulses per revolution	2	A	A	1024 pulses per revolution	Compatible with A06B-6044-H606
	256 pulses per revolution	4	B	A	1024 pulses per revolution	Compatible with A06B-6044-H603 Compatible with A06B-6044-H605
	128 pulses per revolution				512 pulses/rev	
	64 pulses per revolution	8	A	B	512 pulses/rev	For motor model 0.5S only
	————	16	B	B	————	Not used
Phase Z	1 pulse per revolution	1			1 pulse per revolution	Same as usual

(Note) The multiplier is specified with setting pins SH6 and SH7.

4.2.2 Output signal specifications of position coder (connector CN2 signal) - at constant speed of 1500 min^{-1}

(Note) The output signal specifications of a connector number CN19 are defined when A16B-1300-0220 and A16B-1300-0221 are used.

Output point	Item	Specification	Example of waveform
Between CN2-16(PA) and CN2-18(PB), and between CN2-17(*PA) and CN2-19(*PB)	Phase difference	90° ±10° (in the case of CCW rotation viewed from detector)	
CN2-16(PA) CN2-18(PB) CN2-14(SC) CN2-17(*PA) CN2-19(*PB) CN2-15(*SC)	High level	2.5 V minimum	
	Low level	1.2 V maximum	
PA, *PA PB, *PB	Duty ratio	50 ± 7%	
CN2-14(SC) CN2-15(*SC)	Width	116 ± 21 μs	

4.2.3 Output circuit configuration

Balanced output with the line driver IC 75172

4.3 Input Power Supply

Voltage range	Maximum current
+5V +5% -5%	200 mA or less

(Note) Power is fed from the spindle servo unit.

4.4 Maximum Speed

Number of teeth on the detection ring	512 teeth	256 teeth	128 teeth	64 teeth (for interpolation multiplier of 8)
Maximum speed at which the position coder signal can beused	5000 min^{-1}	10000 min^{-1}	20000 min^{-1}	20000 min^{-1}
Maximum speed at which the velocity feedback signal can be used	12500 min^{-1}	25000 min^{-1}	50000 min^{-1}	50000 min^{-1}

(Note) Be sure to set the parameter for the maximum speed enabling detection of a single revolution signal to a value less than or equal to the maximum speed at which the position coder signal can be used. (Otherwise, alarm 47 occurs.)

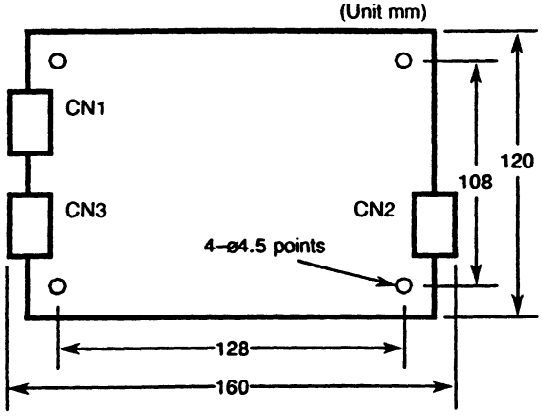
Parameter number	PM	0C	15	16	
	3098	6598 6738	3098 3238	4098	Maximum speed enabling detection of a single revolution signal

4.5 Ambient Temperature

0°C to 55°C

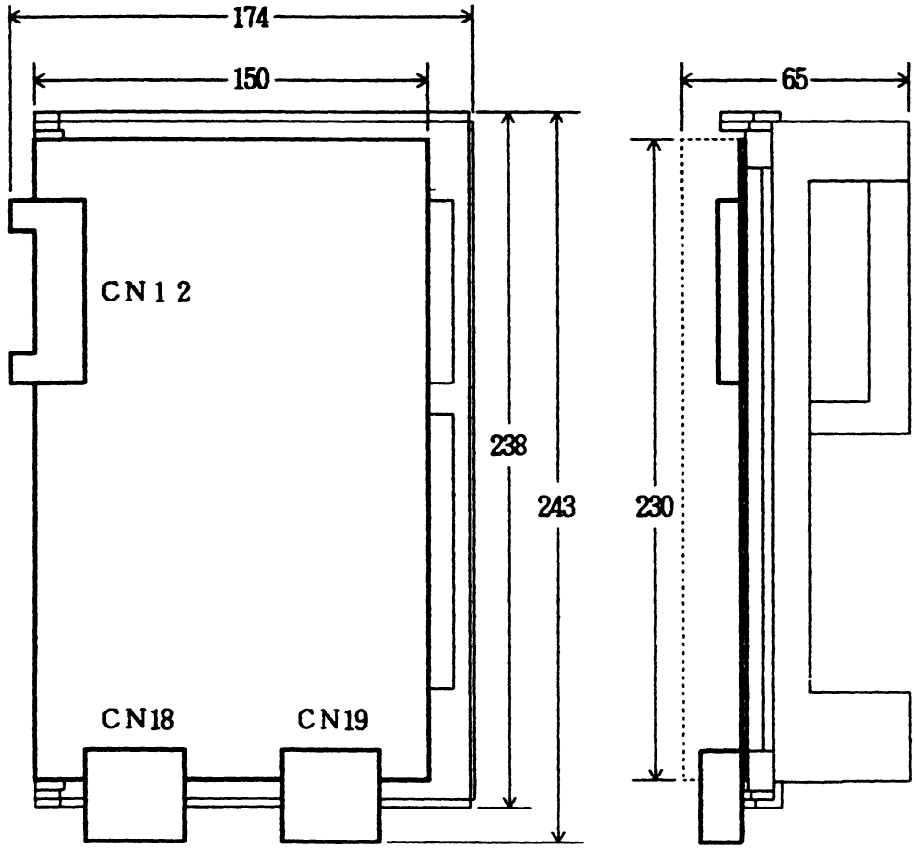
5. EXTERNAL DIMENSIONS

5.1 Separate Type



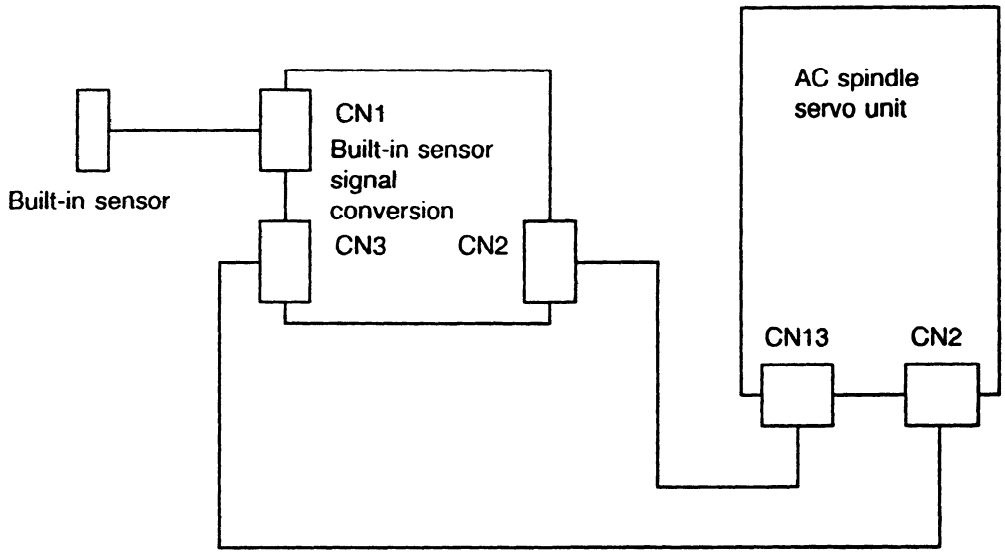
5.2 Unit Mounting Type

(Unit: mm)

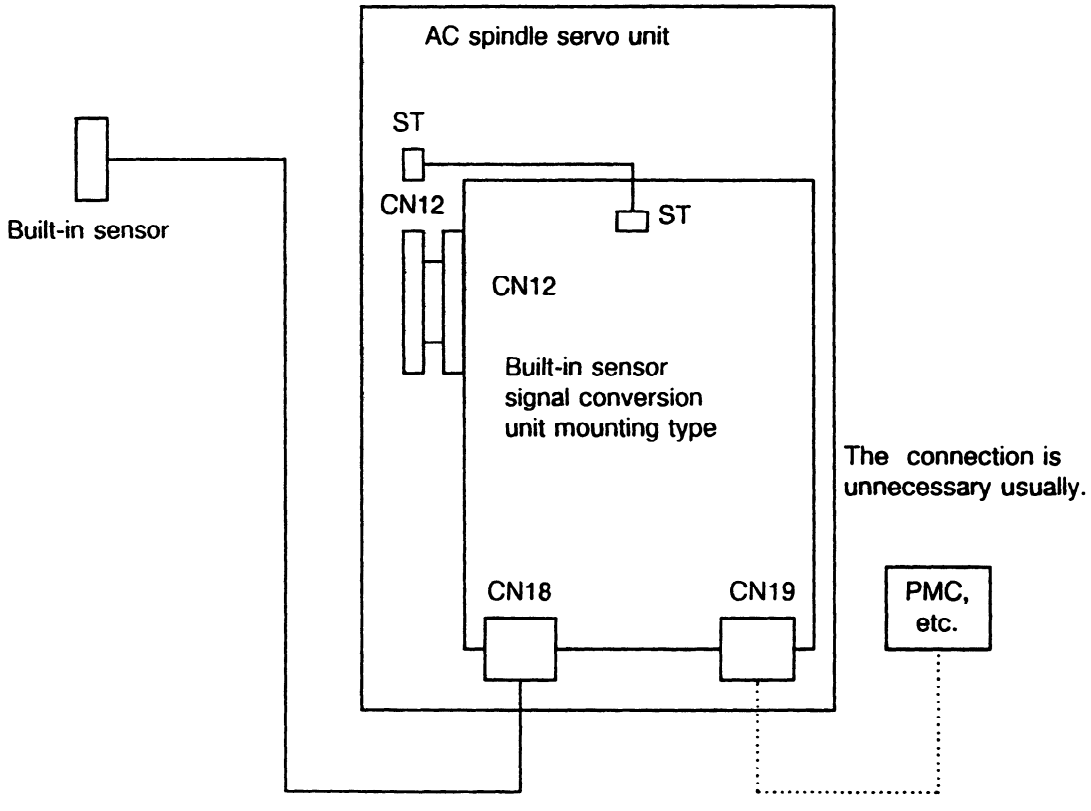


6. CABLE ROUTING DIAGRAM

6.1 Separate Type

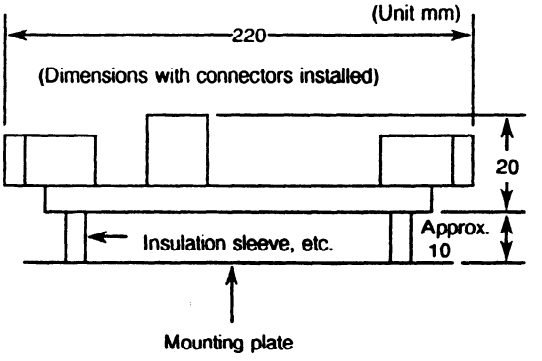


6.2 Unit Mounting Type



7. EXAMPLE OF INSTALLATION

7.1 Separate Type



7.2 Unit Mounting Type

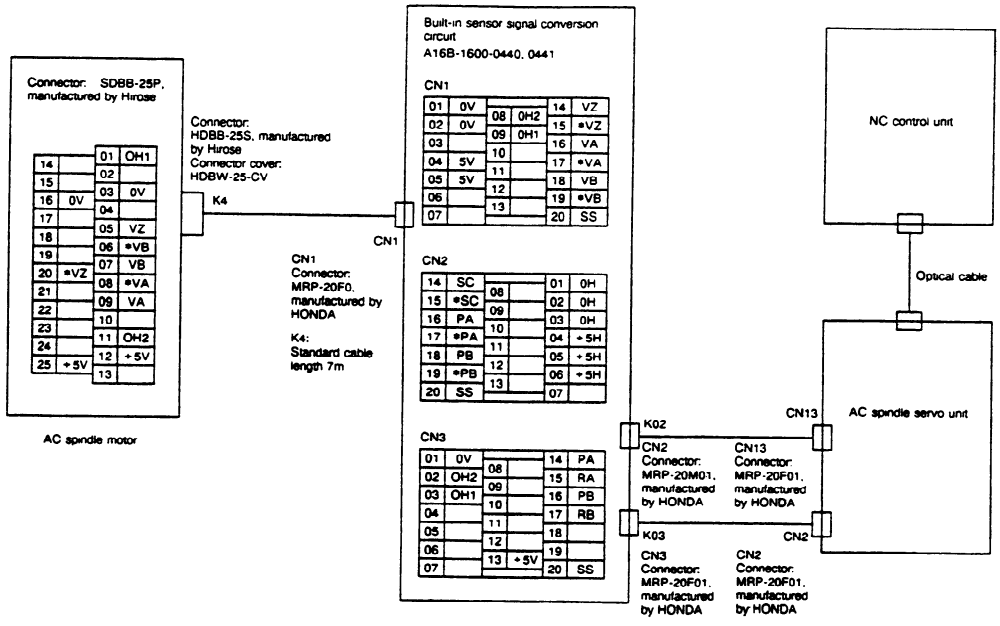
For the outline drawing of the unit mounting type, see Chapter 8 in Part V.

8. CONNECTION

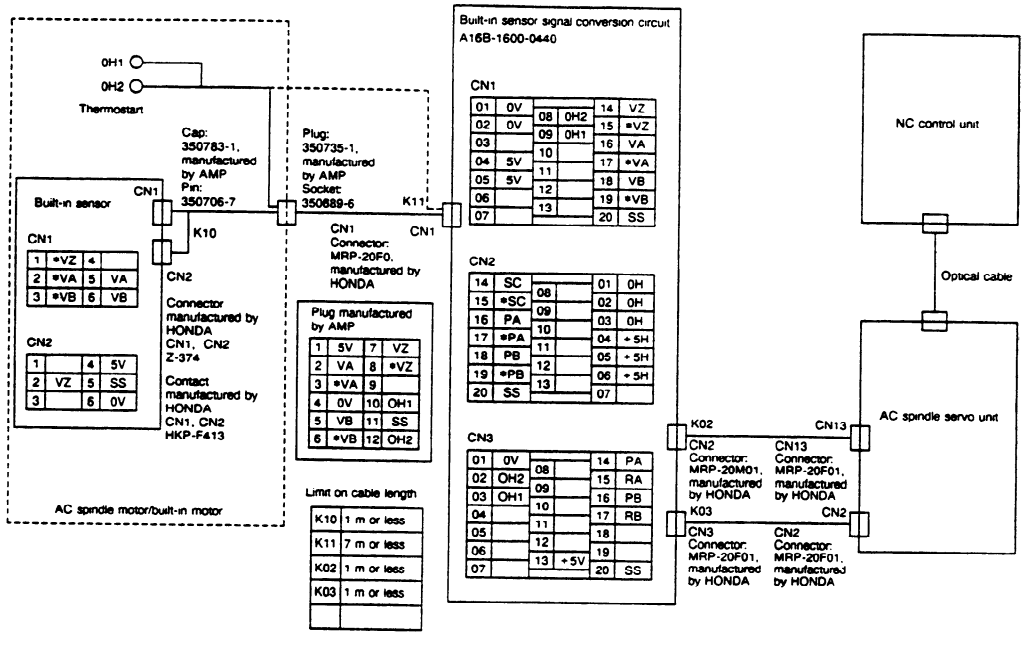
8.1 Block Diagram

8.1.1 Separate type

(1) For motor model 0.5S

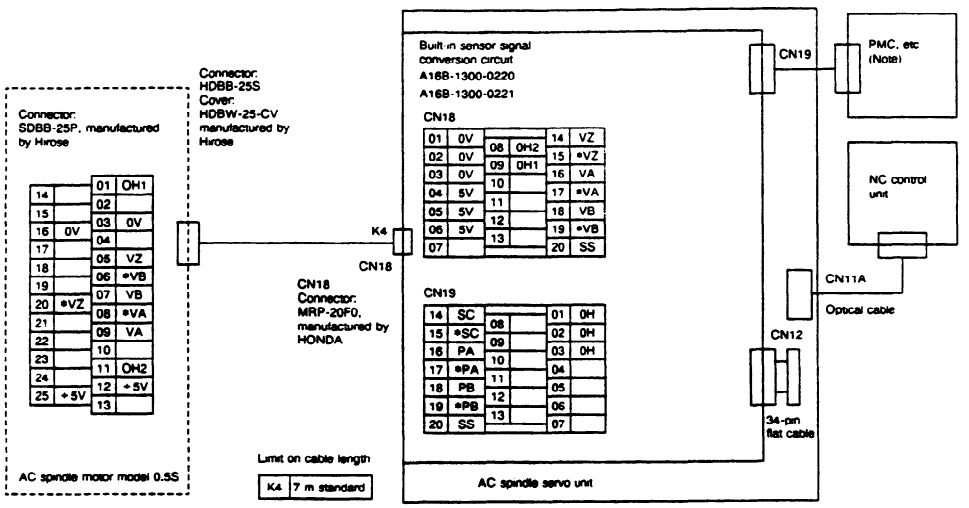


(2) For motor models other than 0.5S



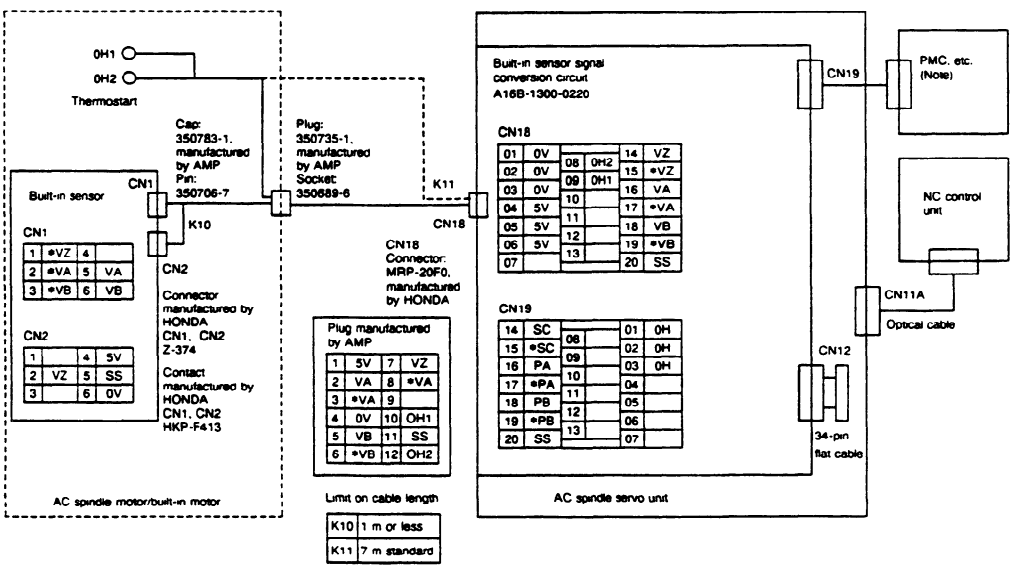
8.1.2 Unit mounting type

(1) For motor model 0.5S



(Note) The connection is unnecessary usually.
Connect when position corder signal is used for PMC, etc.

(2) For motor models other than 0.5S

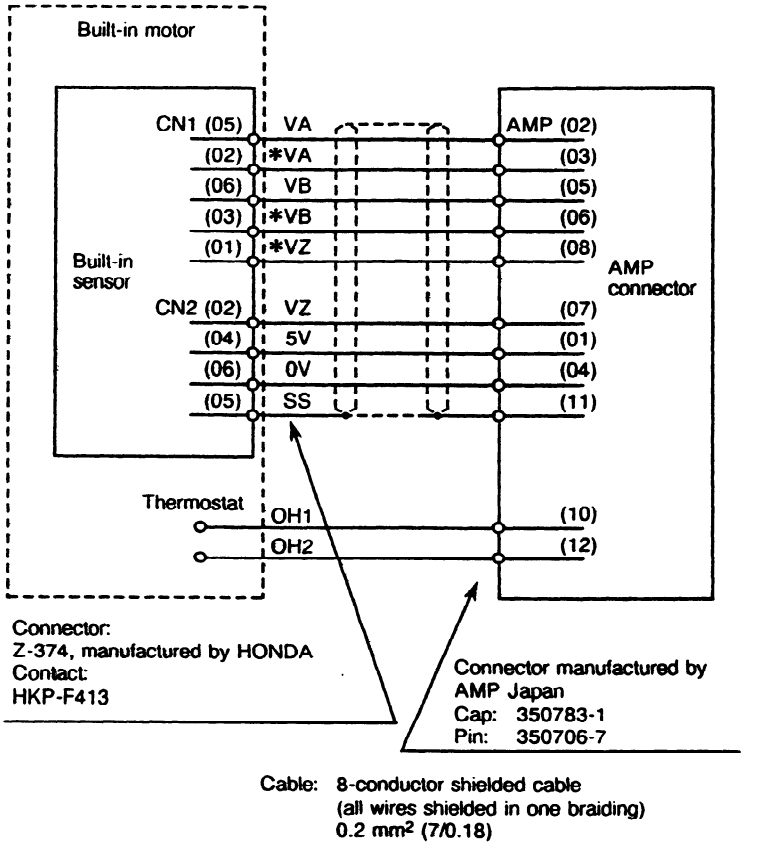


(Note) The connection is unnecessary usually.
Connect when position corder signal is used PMC, etc.

8.2 Details of Connections between Units

8.2.1 Built-in sensor and connector (motor) (cable symbol: K10)

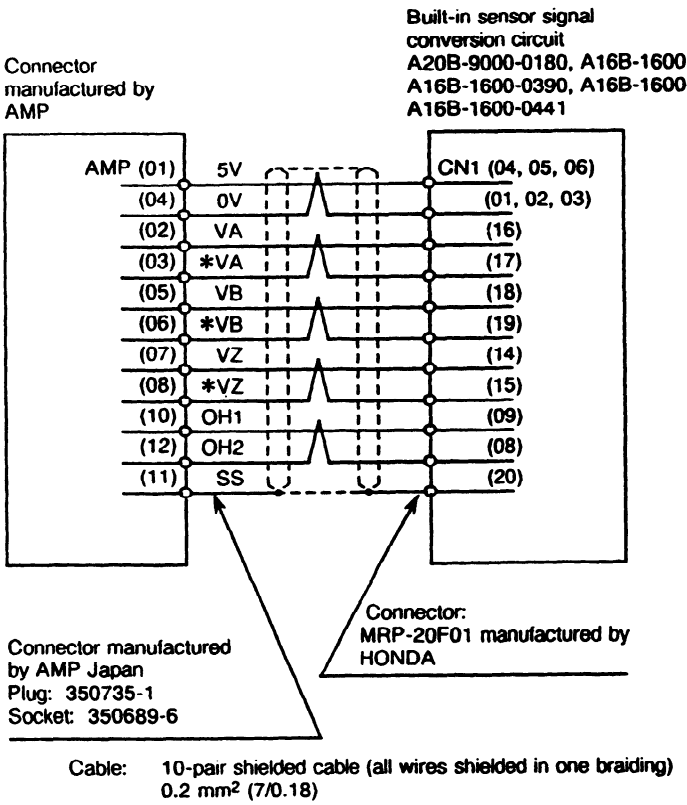
(The cable is incorporated in an AC spindle motor with a built-in sensor.)



(Note) Cable length: 1 m or less

8.2.2 Motor and built-in sensor signal conversion circuit (cable symbol: K11)

(1) Separate type



Reference: For pin crimping and extraction, use the following tools:

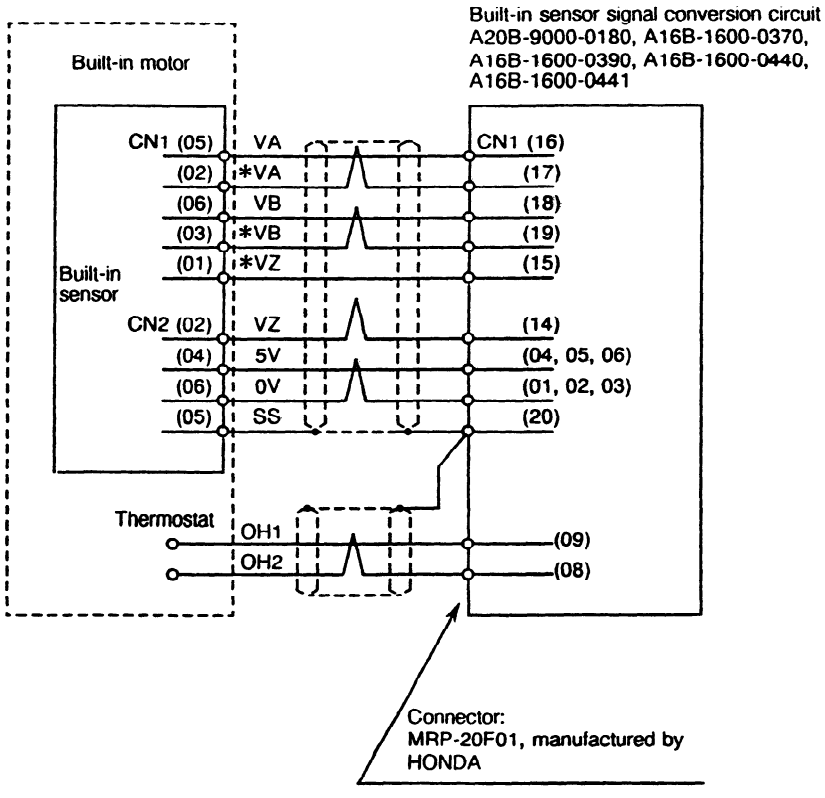
A.M.P. tool type No.	
Grimping tool	90300-2
Extractor	458994-2

(Note 1) AMP manual tool operator's manual: IS 7706

(Note 2) For the manual tool, use a die for wire size 22-24.

(*) See section 9.2 for length of the cable.

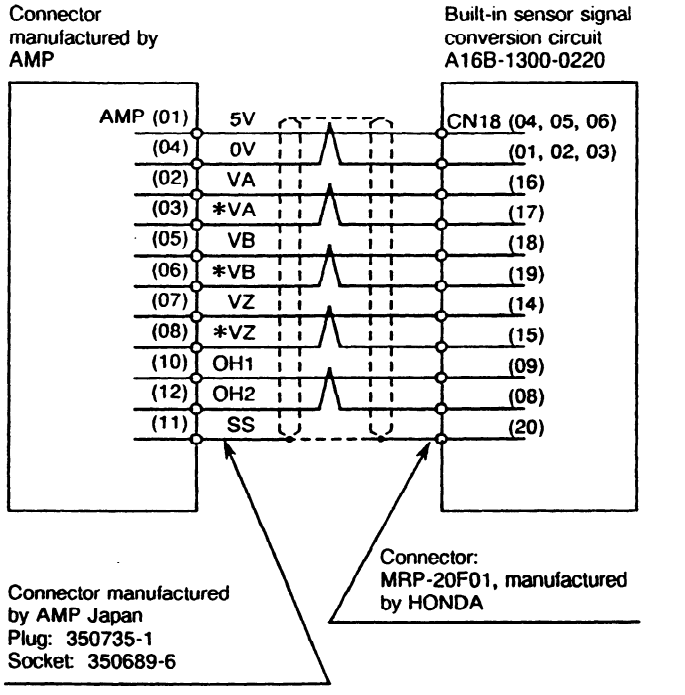
(2) Separate type (when a separate cable is used for the overheat line)



Cable: Shielded cable (all wires shielded in one braiding)
0.2 mm² (7/0.18)

(*) See section 9.2 for length of the cable.

(3) Unit mounting type



Cable: 10-pair shielded cable (all wires shielded in one braiding)
0.2 mm² (7/0.18)

Reference: For pin crimping and extraction, use the following tools:

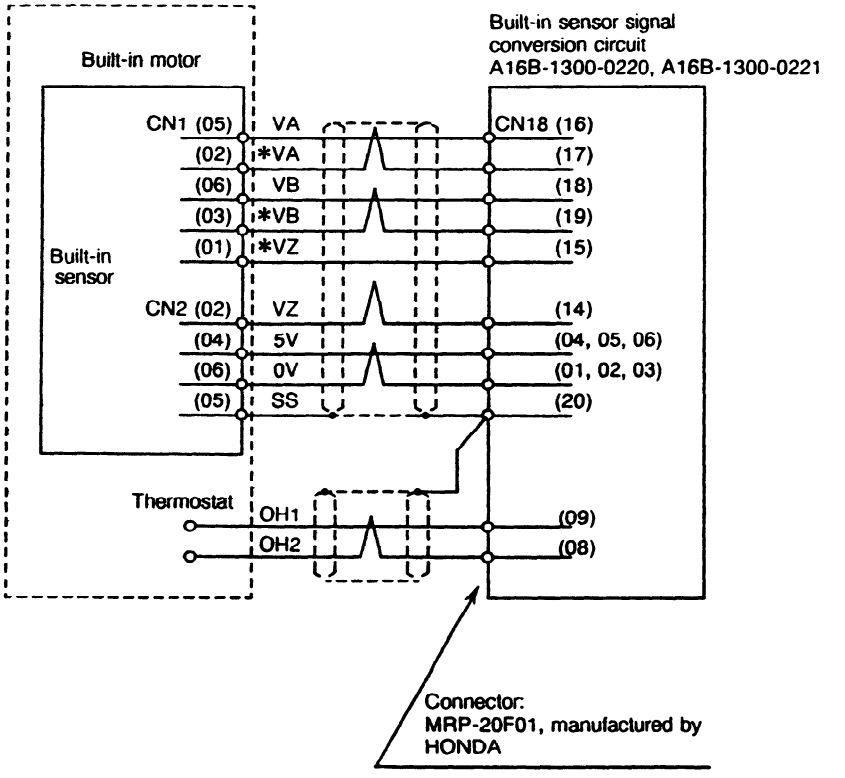
A.M.P. tool type No.	
Grimping tool	90300-2
Extractor	458994-2

(Note 1) AMP manual tool operator's manual: IS 7706

(Note 2) For the manual tool, use a die for wire size 22-24.

(*) See section 9.2 for length of the cable (7m: standard).

(4) Unit mounting type (when a separate cable is used for the overheat line.)

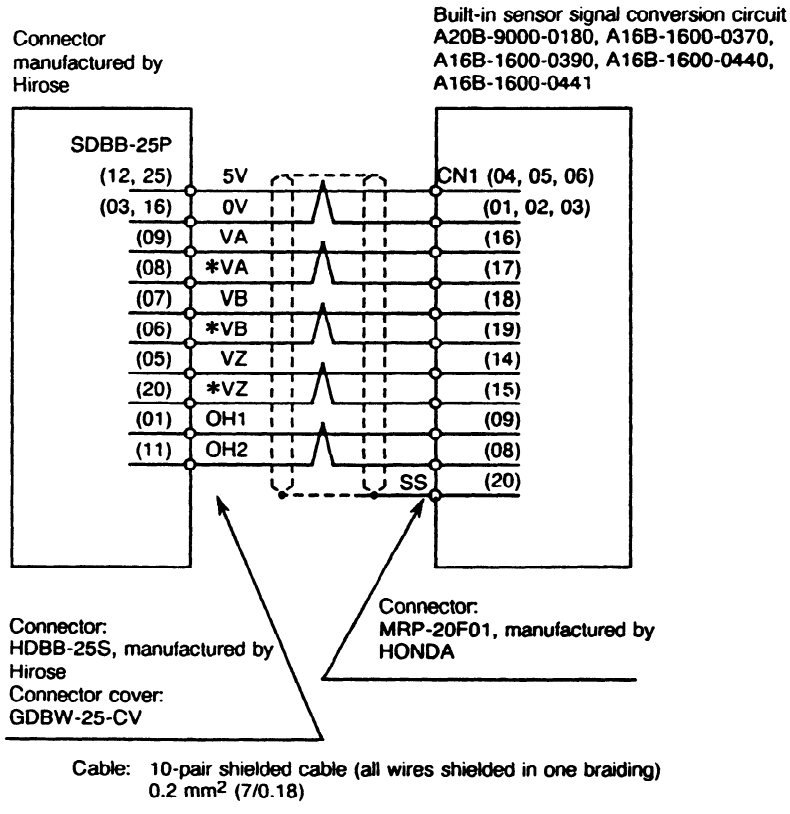


Cable: Shielded cable (all wires shielded in one braiding)
0.2 mm² (7/0.18)

(*) See section 9.2 for length of the cable.

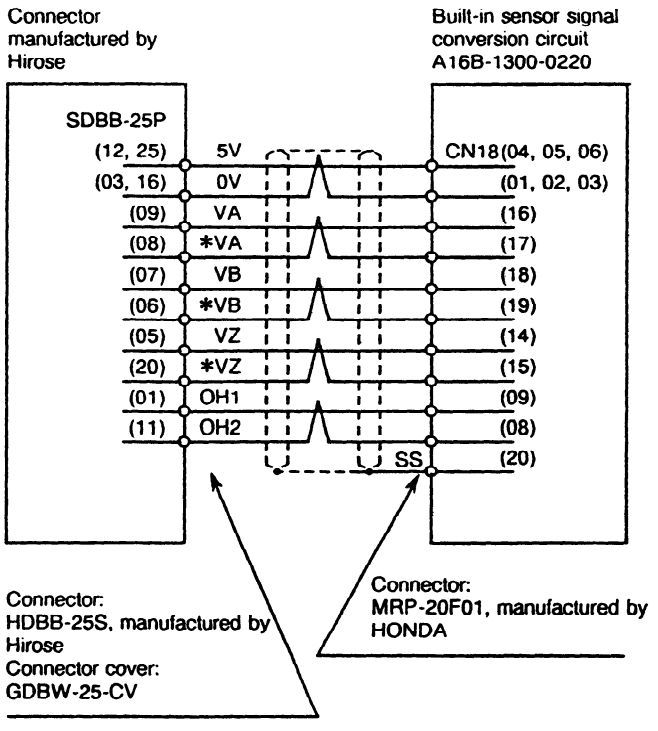
8.2.3 Motor model 0.5S and built-in sensor signal conversion circuit (cable symbol: K4)

(1) Separate type



(*) See section 9.2 for length of the cable (7m : Standard).

(2) Unit mounting type

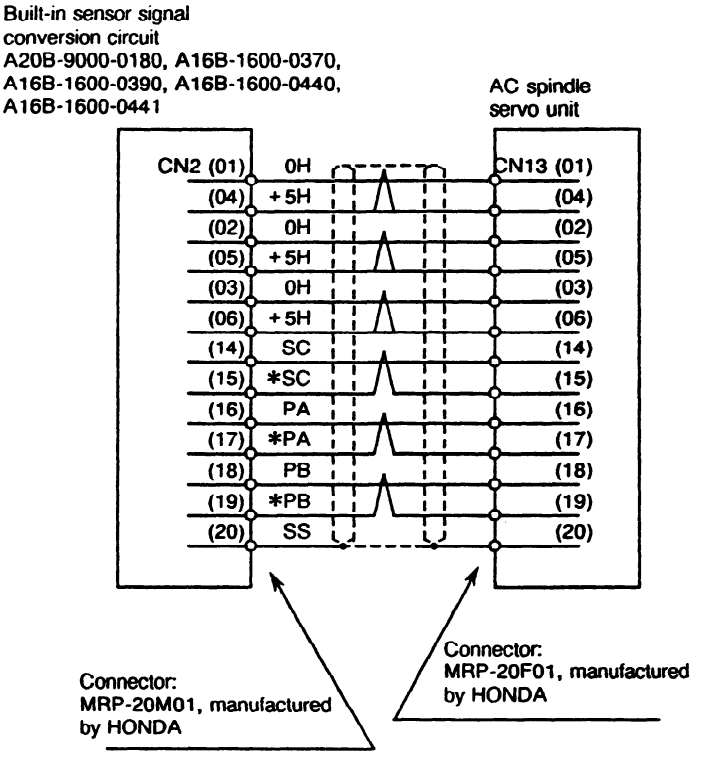


(*) See section 9.2 for length of the cable.

8.2.4 Built-in sensor signal conversion circuit and serial interface series spindle servo unit

(1) Separate type

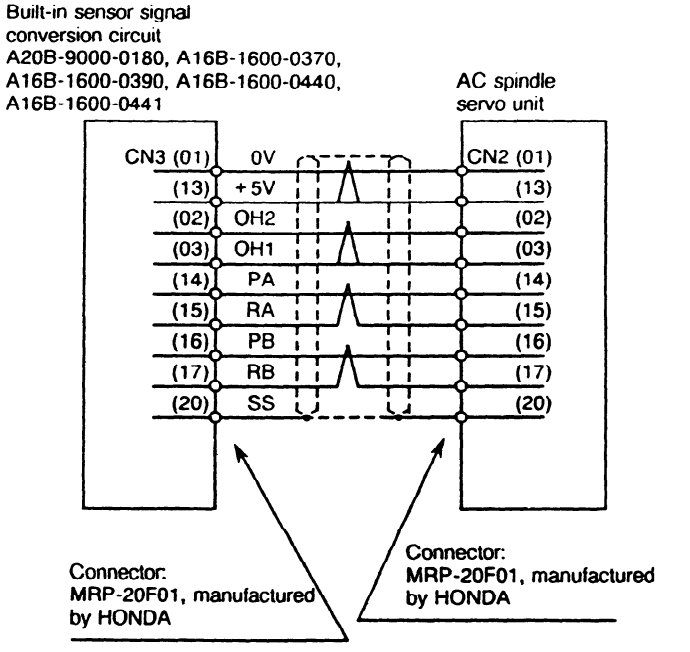
(Cable symbol: K02)



Cable: 10-pair shielded cable (all wires shielded in one braiding)
0.2 mm² (7/0.18)

(Note) This cable (K02) is particularly sensitive to noise. So, use a K02 cable not longer than 1 m, and connect the shield to pin 20 of both connectors.

(Cable symbol: K03)

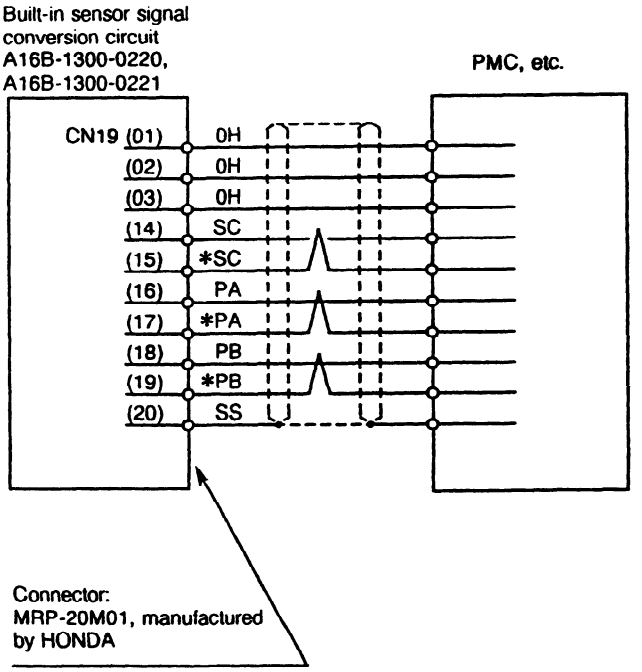


Cable: 10-pair shielded cable (all wires shielded in one braiding)
0.2 mm² (7/0.18)

(Note) Cable length: 1 m or less

(2) Unit mounting type (when the position coder signal is used by the PMC, etc.)

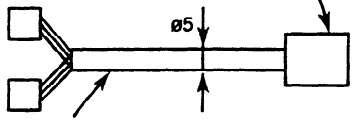
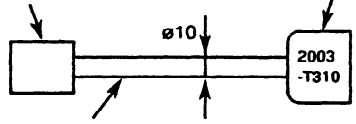
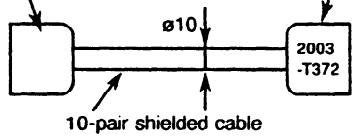
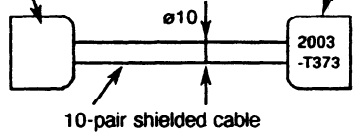
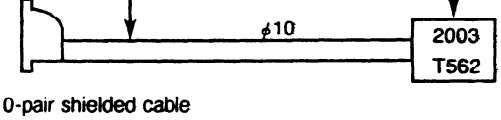
(Connector symbol: CN19) : The connection is unnecessary usually.



Cable: 10-pair shielded cable (all wires shielded in one braiding)
0.2 mm^2 (7/0.18)

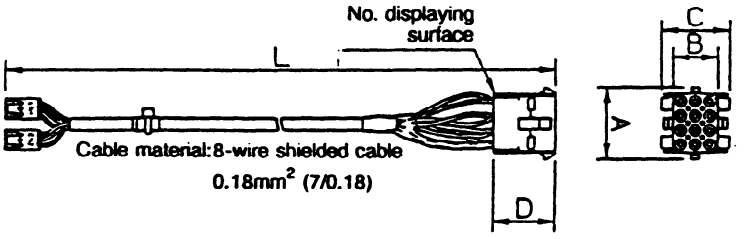
9. CABLES

The table below indicates the cable specifications.

Used for	Symbol	General specifications	FANUC specification
Built-in sensor | Plug manufactured by AMP	K10	Connector: Z-374, manufactured by HONDA Contact: HKP-F413 Cap: 350783-1, manufactured by AMP Pin: 350706-7  8-conductor shielded cable (all wires shielded in one braiding) 0.2 mm² (7/0.18)	A06B-6059-K804 (0.5 m) A06B-6059-K805 (1 m)
AC spindle motor or cap manufactured by AMP | Buil-in sensor signal conversion circuit	K11	Plug: 350735-1, manufactured by AMP Socket: 350689-6 MRP-20F01  10-pair shielded cable (all wires shielded in one braiding) 0.2 mm² (7/0.18)	A06B-6059-K806 (7 m)
Built-in sensor signal conversion circuit | AC spindle servo unit	K02	MRP-20M01 MRP-20F01  10-pair shielded cable (all wires shielded in one braiding) 0.2 mm² (7/0.18)	A06B-6059-K800 (1 m)
Built-in sensor signal conversion circuit | AC spindle servo unit	K03	MRP-20F01 MRP-20F01  10-pair shielded cable (all wires shielded in one braiding) 0.2 mm² (7/0.18)	A06B-6059-K801 (1 m)
AC spindle motor model 0.5S | Built-in sensor signal conversion circuit	K04	Connector: HDBB-25S, manufactured by Hirose Connector cover: HDBW-25-CV MRP-20F01  10-pair shielded cable (all wires shielded in one braiding) 0.2 mm² (7/0.18)	A06B-6064-K800 4 m long A06B-6064-K801 7 m long

9.1 Details of the Cable (K10)

FANUC specification number A06B-6059-K804 (0.5m)
A06B-6059-K805 (1m)



1) Cable dimensions

	Dimension	Dimension
Symbol	A06B-6059-K804	A06B-6059-K805
A	26.67	26.67
B	20.32	20.32
C	25.91	25.91
D	27.43	27.43
L	500 ± 20	1000 ± 20

2) Detector connection

1	2	3
Red	Black	Blue
5V	VA	*VA
4	5	6
White/yellow	Green	White/orange
0V	VB	*VB
7	8	9
Gray	White/brown	
VZ	*VZ	
10	11	12
	Blue/transparent	
OH (*1)	SS	OH (*1)

(*1) To numbers 10 and 12, connect the OH line of the motor.

3) Accessories

Name	Manufacturer	Type number	Qty
Plug	A.M.P	350735-1	1
Split pin	A.M.P	350706-7	2
Socket	A.M.P	350689-6	10

Reference: For pin crimping and extraction, use the following tools:

A.M.P. tool type No.	
Grimping tool	90300–2
Extractor	458994–2

(Note 1) AMP manual tool operator's manual: IS 7706
(Note 2) For the manual tool, use a die for wire size 22-24.

9.2 Cable (K11) Length

Specifications of the built-in sensor

Internal impedance	120Ω
Consumption current	41.67mA

The total voltage drop across a cable both ways must be restricted to 0.15 V or less.
If a cable with resistance A is used, the maximum length of the cable (one way) is found from the formula:

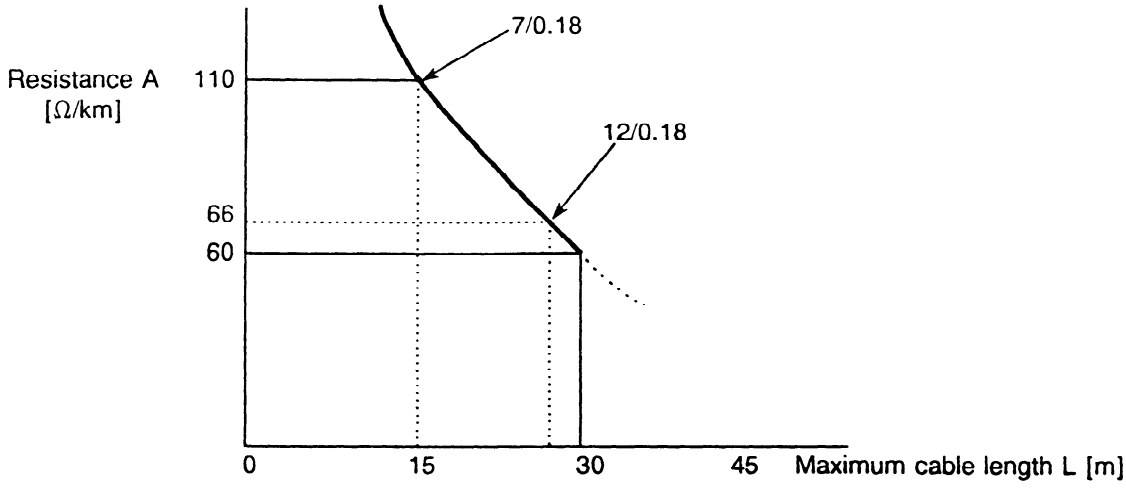
$$L = \frac{1800}{A}$$

L: Maximum cable length [m]
A: Resistance of a cable used [Ω/km]

Reference: Cable resistance

7/0.18 (0.2mm²) . . . 110Ω/km
12/0.18 (0.3mm²) . . . 66Ω/km
20/0.18 (0.5mm²) . . . 40Ω/km

The following figure shows the relationship between resistance and the maximum cable length.



Cable used	Maximum cable length
7/0.18	16.4m
12/0.18	27.3m

(Note) The maximum length of the cable shall be 30 m.

10. CAUTIONS IN USE

(1) Adjustment

For matching between the built-in sensor and signal conversion circuit, adjustments need to be made at the time of installation. For detailed information about adjustments, refer to the "Maintenance Manual" (B-65045E).

① Offset voltage adjustment (for A16B-1600-0440, A16B-1600-0441, A16B-1300-0220 and A16B-1300-0221)

Adjustment location	Measurement location	Measurement conditions	Adjustment value	Remarks
VR1	CH7-CH10	Rotation direction: CW and CCW Speed: 1500 min^{-1} Test equipment: DC voltmeter (DC range of digital multimeter, etc.) or oscilloscope	0 ± 35mV	Make adjustment to place centers of CW and CCW adjustment values close to 0 mV.
VR2	CH8-CH10		− 85mV to − 345mV	Make adjustment to place centers of CW and CCW adjustment values close to -200 mV.
VR3	CH9-CH10			

(2) Orientation for using the built-in sensor

	Number of detection pulses/rev	Signal conversion circuit interpolation multiplier	Number of equivalent position corder signal output pulses/rev	Detection unit	Repeatability	
Phase A Phase B	512 pulses/rev	2	1024 pulses/rev	0.088°	±0.2°	(*1)
	256 pulses/rev	4	1024 pulses/rev	0.088°	±0.2°	
	128 pulses/rev	4	512 pulses/rev	0.176°	±0.4°	
	64 pulses/rev	4	256 pulses/rev	0.352°	±0.8°	
	64 pulses/rev	8	512 pulses/rev	0.176°	±0.4°	
Phase Z	1 pulse/rev		1 pulse/rev	——	——	

(*1) Error components due to the machine are excluded. A fluctuation of ±1 detection unit occurs at the time of stop at a fixed position by orientation.

(3) To prevent malfunction due to noise and fluctuation at the time of stop by orientation, note the following:

① Do not run the signal cable (K10) and power cable through the same duct. In addition, separate the signal cable (K11) from the power cable as far as possible.

② When using cables, be sure to use shield wires, and connect a shield wire to the SS pin of each connector. (K10, K11, K02, K03)

③ The cables (K02 and k03) used between the built-in sensor signal conversion circuit and spindle servo unit are particularly sensitive to noise. So, use K02 and K03 cables not longer than 1 m, and run these cables away from the power cable and cable for the power supply.

④ Be sure to pair the signal lines in a signal cable correctly.

⑤ If the spindle servo unit and motor are not connected to ground correctly, a speed feedback signal, speed command voltage, and so forth may pick up noise, thus causing fluctuation at the time of stop by orientation, erratic rotation, abnormal sound, and so on. Connect the spindle servo unit and motor to ground according to Item (4) below.

(4) Grounding

① Connect the G terminal on the power magnetics cabinet to the G terminal on the spindle servo unit.

② Connect the G terminal on the spindle servo unit to the G terminal on the spindle motor.

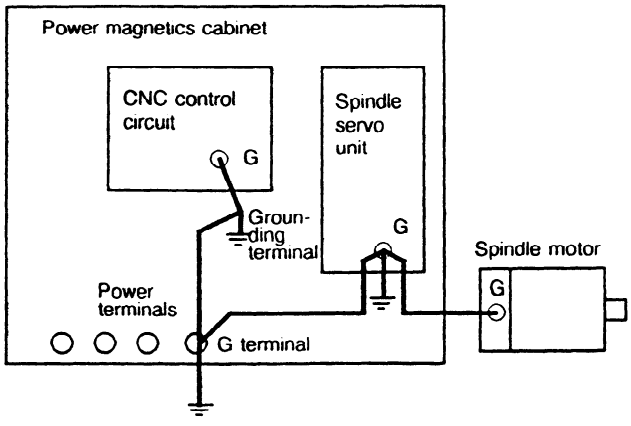
③ Connect the G terminal on the spindle servo unit to the nearest point of the power magnetics cabinet frame.

Reason: If the connection point is far from the G terminal on the power magnetics cabinet, grounding may not be sufficient.

④ Connect the G terminal on the power magnetics cabinet to an external ground wire.

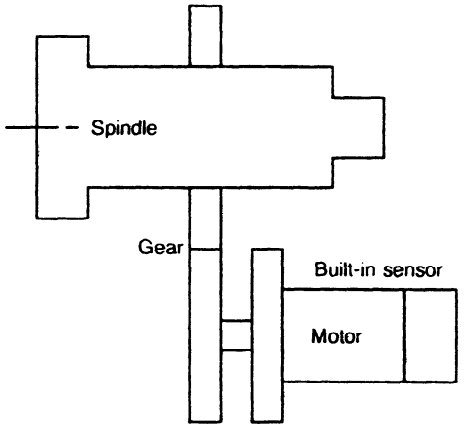
(Note 1) Connect the G terminal of the power magnetics cabinet to a ground terminal installed according to Section 3 of "Technical Standard for Electric Installation."

(Note 2) Use a thick (5.5 mm^2 or more) wire when connecting the G terminal on the CNC control circuit to a ground G terminal, and the G terminal on the power magnetics cabinet to a ground terminal. Both connections should be made as close to each other as possible.

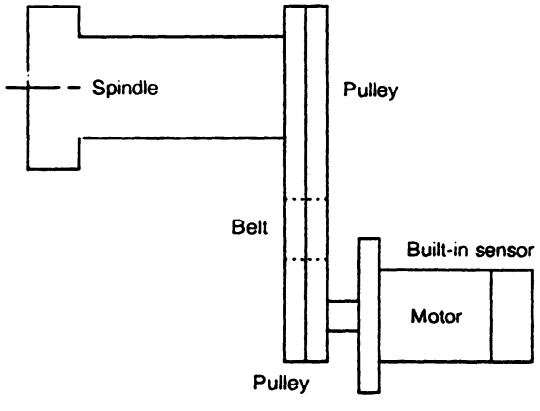


(5) With a machine that has the spindle linked with a motor by using a gear or belt, a deteriorated thread precision may be produced for causes including a gear backlash or stretched belt when rigid tapping is performed using a sensor built into the motor.

[Backlash]



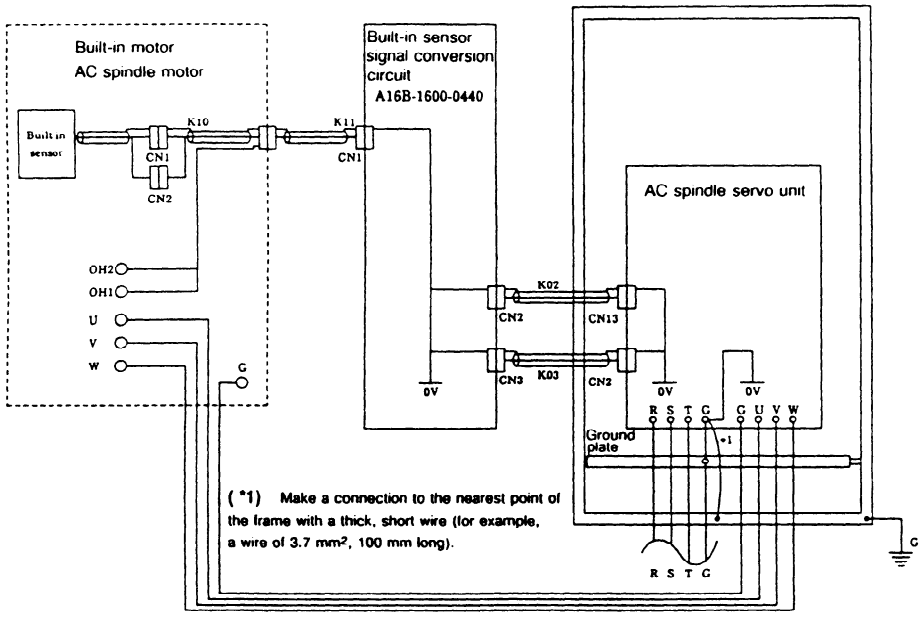
[Belt stretch]



If there is a backlash of 1 mm on the periphery of a gear (ϕ100), an error of 0.573° (= 1/(2π 100) × 360°) occurs at thread roots.

(6) With a machine that has the spindle linked with a motor by using a gear or belt, orientation using a sensor built into the motor cannot be performed.

(7) Shield grounding diagram



XIII. HIGH RESOLUTION MAGNETIC PULSE CODER

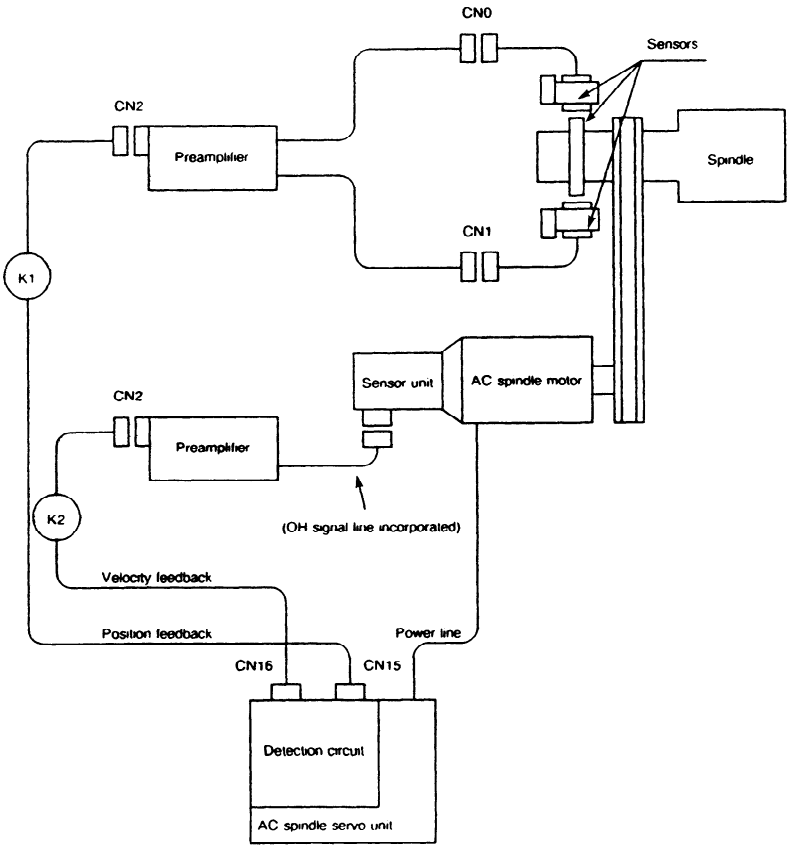
1. GENERAL

This sensing system has been developed specially for the spindle servo control.
Magnetic encoders are used as sensors in conjunction with a detection circuit. This setup allows the sensing in 360,000 divisions (1/1000 degrees).
The following optional circuits cannot be used together with the detection circuit for a high resolution magnetic pulse coder.

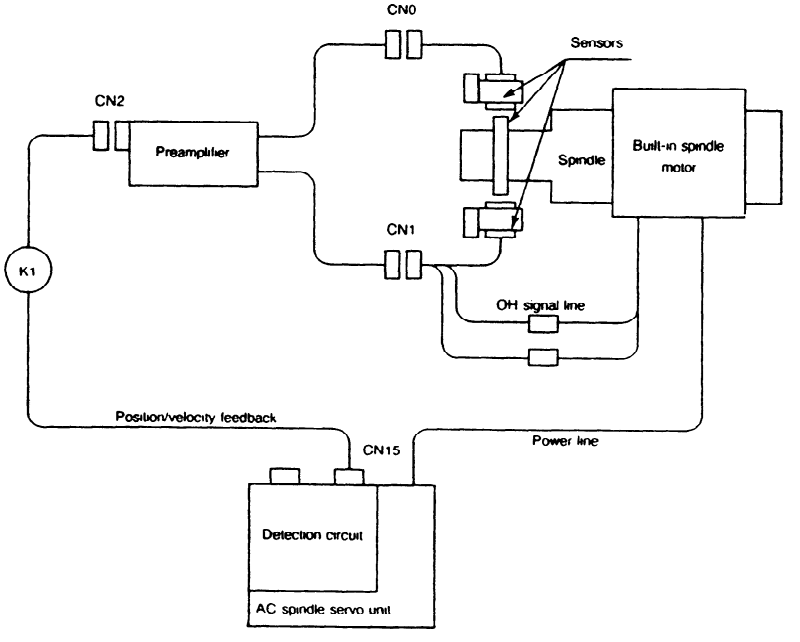
Optional circuit unusable with detection circuit for a high resolution magnetic pulse coder	
Name	Specification drawing number
Spindle switching control circuit	A06B-6064-J701 A06B-6064-J702
Position coder signal input circuit	A06B-6064-J703
Detection circuit for a high-resolution position coder	A06B-6064-J705
Built-in signal conversion circuit for a built-in sensor	A06B-6064-J704 A06B-6064-J706

2. SYSTEM CONFIGURATION

2.1 Motor and Spindle Linked Belt or Similar Device



2.2 Built-in Spindle Motor



3. SPECIFICATION METHOD

3.1 Sensor

Sensor	Application	External diameter of magnetic drum
A860-0382-T121	General spindle (No OH signal line)	ϕ65
A860-0382-T141	Built-in motor (Incorporates OH signal line)	
A860-0382-T123	General spindle (No OH signal line)	ϕ130
A860-0382-T143	Built-in motor (Incorporates OH signal line)	
A860-0382-T124	General spindle (No OH signal line)	ϕ195
A860-0382-T144	Built-in motor (Incorporates OH signal line)	

(Note 1) Sensors include preamplifiers.

(Note 2) The specifications of the sensors were changed.

Never mix a conventional high-resolution magnetic pulse coder with a new pulse coder; that is a pulse coder based on a sinusoidal sensor. If a conventional sensor and a new drum or a conventional drum and a new sensor are used in combination, normal signals are not output. Carefully check the parts used in your system, for example, at the time of maintenance.

3.2 Detection Circuit

Detection circuit	Application	Applicable sensor
A06B-6064-J720	General spindle ϕ65	A860-0382-T121
A06B-6064-J724	Built-in motor ϕ65	A860-0382-T141
A06B-6064-J721	General spindle ϕ130	A860-0382-T123
A06B-6064-J725	Built-in motor ϕ130	A860-0382-T143
A06B-6064-J722	General spindle ϕ195	A860-0382-T124
A06B-6064-J726	Built-in motor ϕ195	A860-0382-T144

(Note) The spindle servo units used in the conventional types of models 6S to 26S (A06B-6063-HXXX#511) have other drawing numbers.

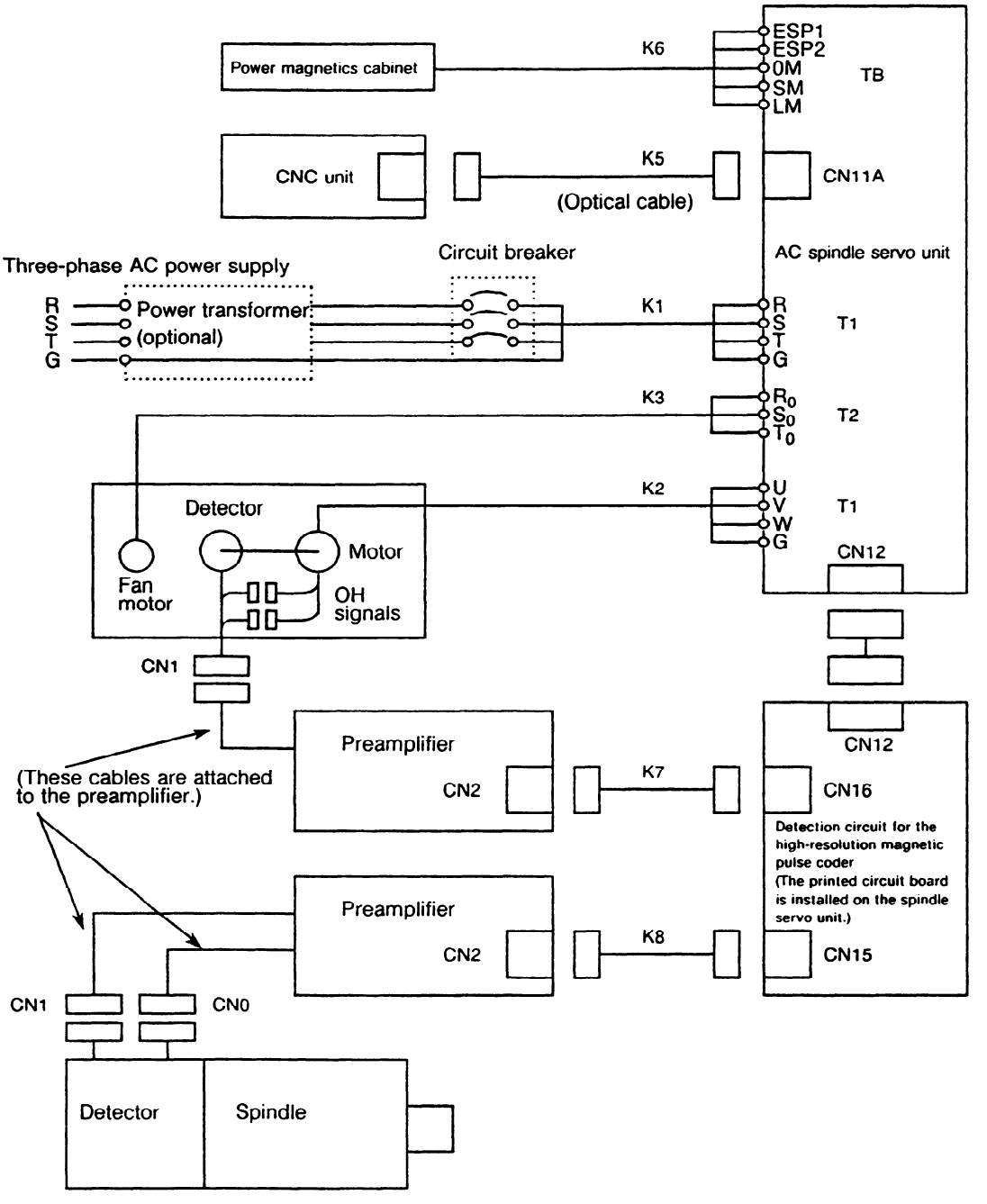
4. SPECIFICATION

Item	Specification		
Supply voltage	5V ± 5%		
Output signal	Cs contour control signal		A, B
	Position encoder signal		A, B
	Full rotation signal		Z
Output pulses	Cs contour control signal		90,000 pulses / rotation
	Position encoder signal	A860-0382-T121 A860-0382-T141	1,024 pulses / rotation
		A860-0382-T123 A860-0382-T143	2,048 pulses / rotation
		A860-0382-T124 A860-0382-T144	3,072 pulses / rotation
Resolution	Cs contour control signal		360,000 pulses / rotation
	Position encoder signal	A860-0382-T121 A860-0382-T141	4,096 pulses / rotation
		A860-0382-T123 A860-0382-T143	8,192 pulses / rotation
		A860-0382-T124 A860-0382-T144	12,288 pulses / rotation
Maximum permitted speed	A860-0382-T121, T141		15,000 min^{-1}
	A860-0382-T123, T143		10,000 min^{-1}
	A860-0382-T124, T144		6,500 min^{-1}
Working temperature range	Sensor, preamplifier, detection circuit		0°C-50°C

5. CONNECTIONS

5.1 Connection Diagram

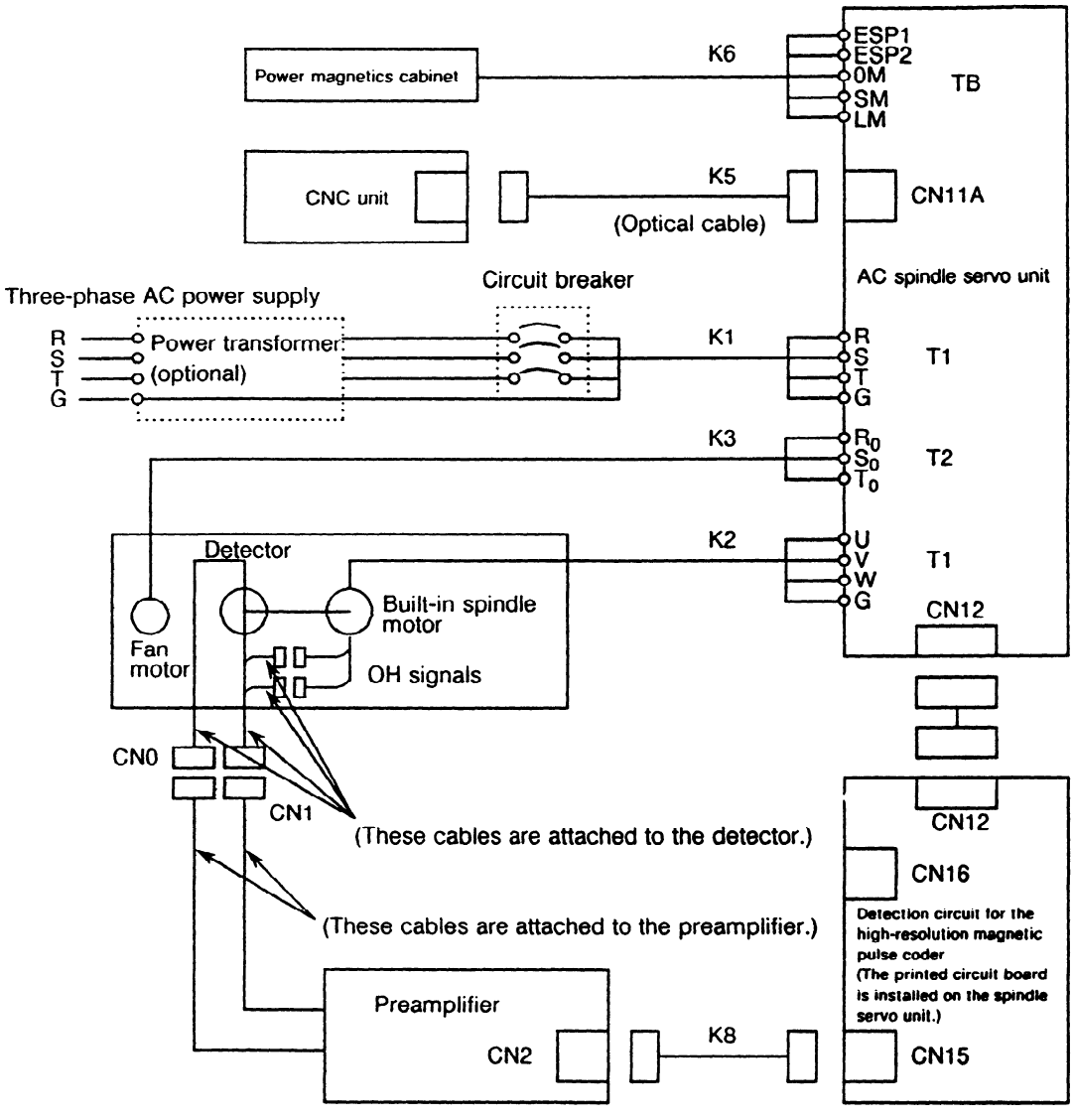
(1) When a motor and the spindle are connected with a belt



(Note) The high-resolution magnetic pulse coder outputs a position coder signal. The pulse coder is connected to the CNC unit through cable K5.

Cables K7 and K8 are provided with a length of 7m. Cables other than these must be prepared by the machine tool builder according to (1) and (2) in 5.3 Cable Details.

(2) Built-in spindle motor

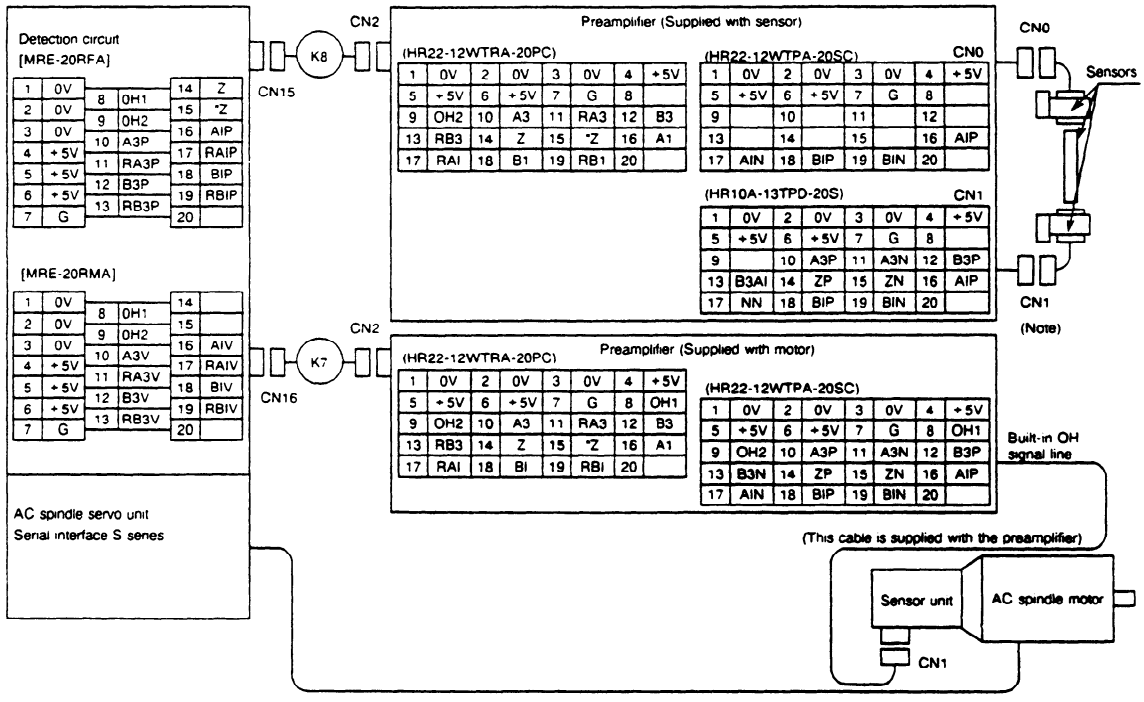


(Note) The high-resolution magnetic pulse coder outputs a position coder signal. The pulse coder is connected to the CNC unit through cable K5.

Cable K8 is provided with a length of 7m. Cables other than this must be prepared by the machine tool builder according to (1) in 5.3 Cable Details.

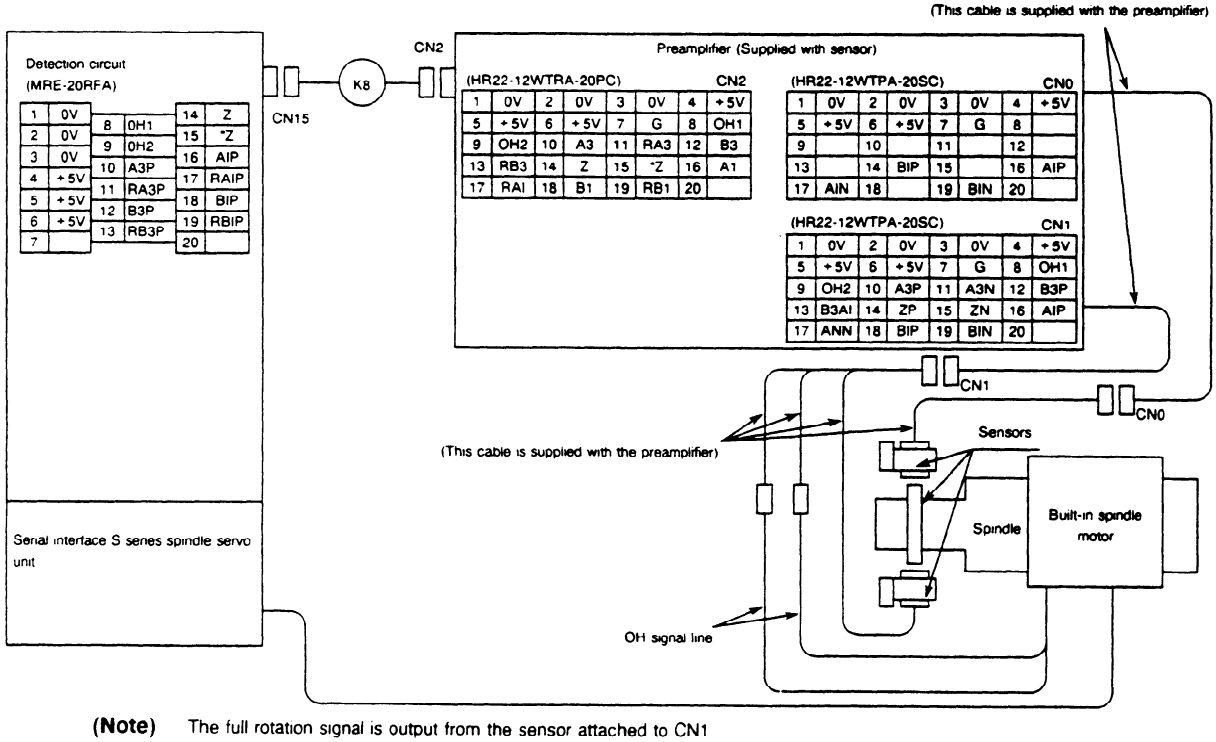
5.2 Connection Diagram of the AC Spindle Servo Unit and AC Spindle Motor

(1) Motor and spindle linked belt or similar device



(Note) The full rotation signal is output from the sensor attached to CN1

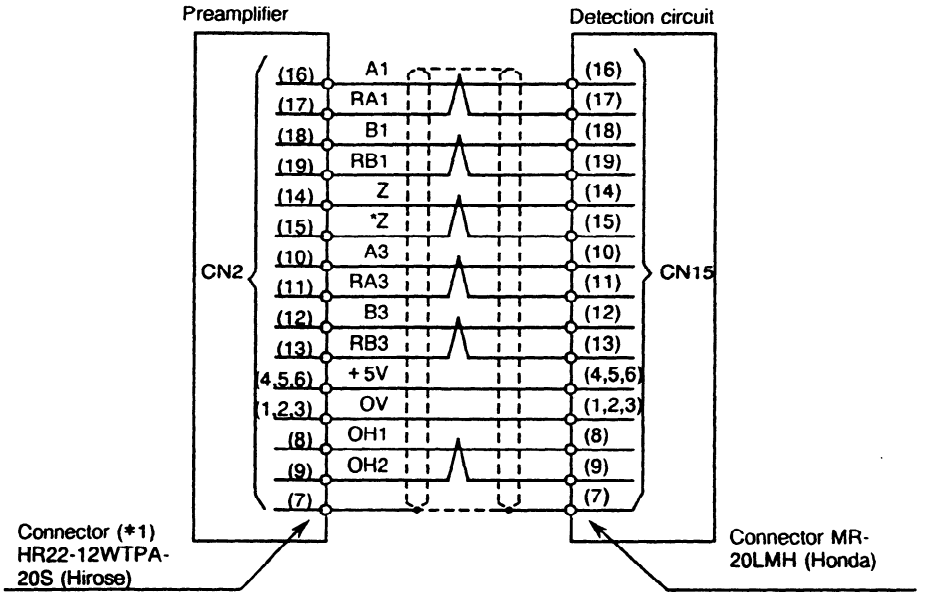
(2) Built-in spindle motor



(Note) The full rotation signal is output from the sensor attached to CN1

5.3 Cable Details

(1) Details of cable K8 (cable for spindle sensor)



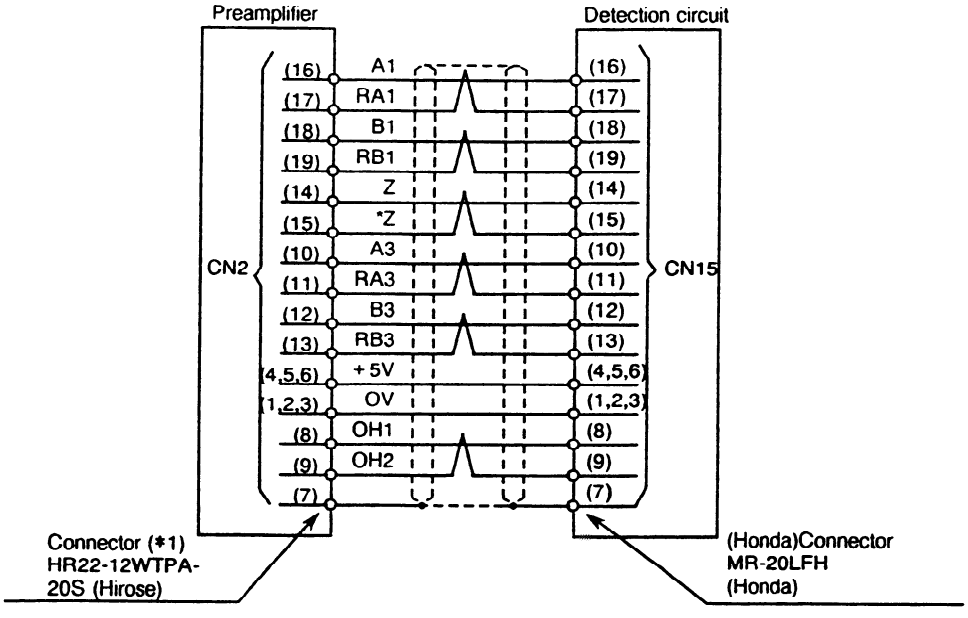
Cable: Max. length 14m
+5V, 0V: 3 wires each of minimum size 0.3mm^2
Other wires: General pair shield wires of minimum size 0.18mm^2

Drawing No. for the appropriate Fanuc cable: A06B-6063-K801 Cable length 7m

(*1) This is a solder type connector. A crimp type connector can also be used.
- Solder type connector: HR22-12WTPA-20S
- Crimp type connector
  Crimp pin: HR22-SC-122 (20 pins are needed for one connector.)
  Connector housing: HR22-⑫WTPA-20SC

When the crimp connector is used, use the following manual crimp tool.
Crimp tool: HR22-TA2428HC (Hirose)

(2) Details of cable K7 (cable for spindle sensor)



Cable: Max. length 14m

+5V, 0V: 3 wires each of minimum size 0.3mm^2

Other wires: General pair shield wires of minimum size 0.18mm^2

Drawing No. for the appropriate Fanuc cable: A06B-6063-K801 Cable length 7m

(*1) This is a solder type connector. A crimp type connector can also be used.

- Solder type connector: HR22-12WTPA-20S
- Crimp type connector

  Crimp pin: HR22-SC-122 (20 pins are needed for one connector.)

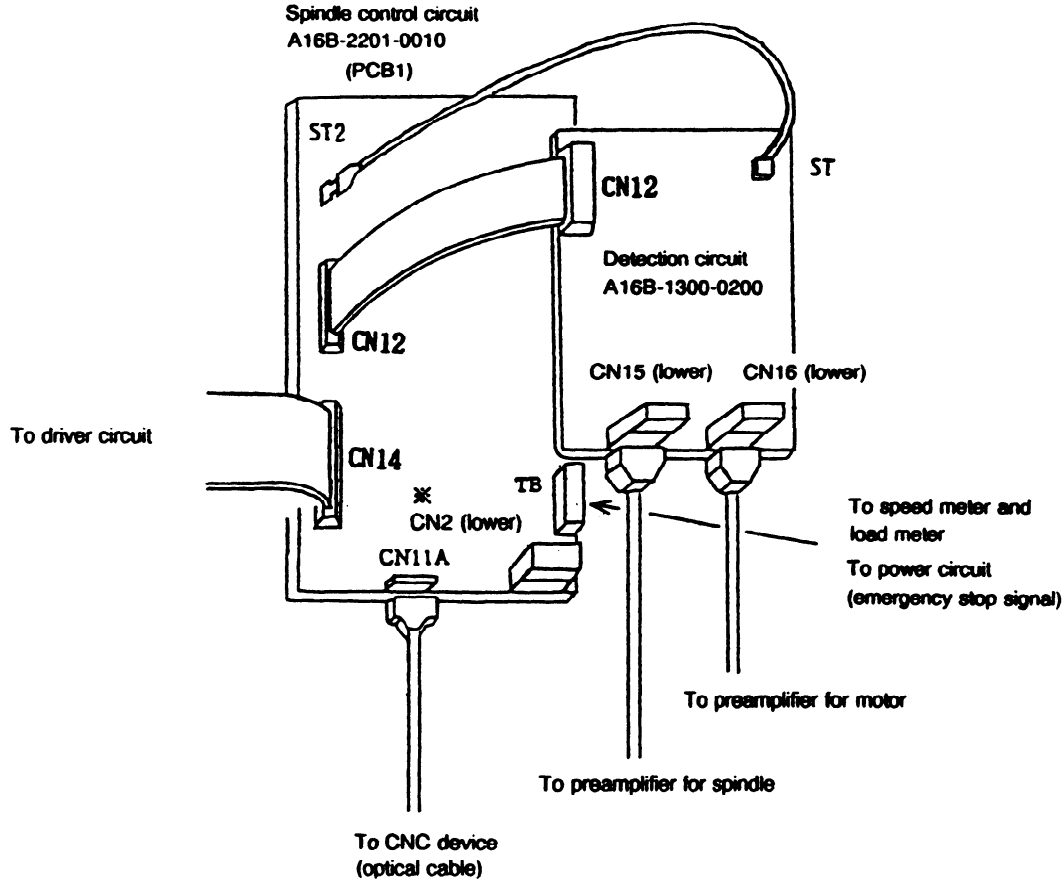
  Connector housing: HR22-⑫WTPA-20SC

  When the crimp connector is used, use the following manual crimp tool.

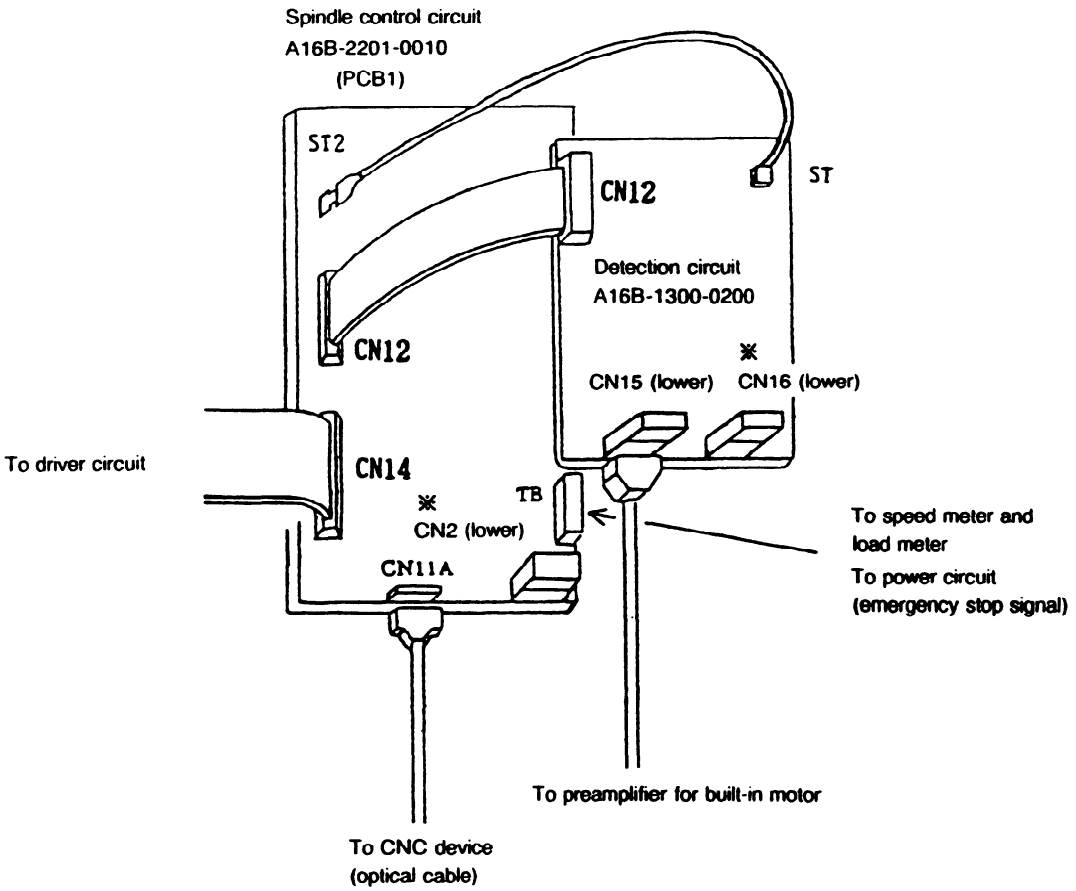
  Crimp tool: HR22-TA2428HC (Hirose)

5.4 Cable Routing Diagrams

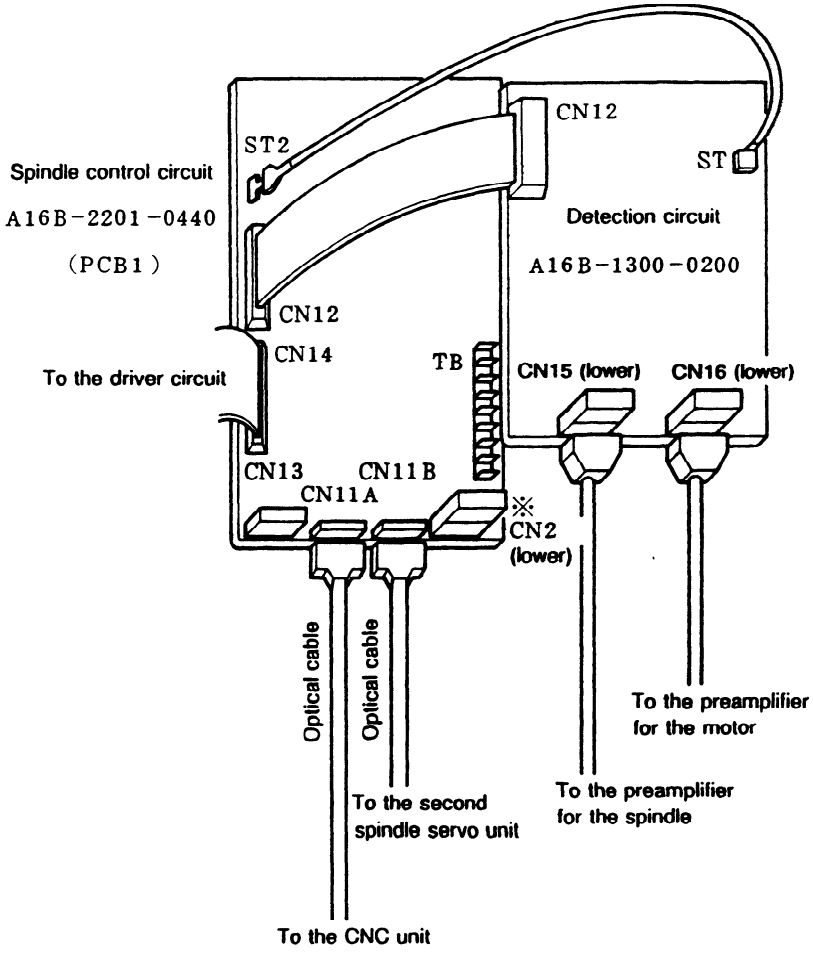
(1) Cable routing diagram when the motor and the spindle is linked with a belt or the like (Models 2S, 3S, 30S, 40S)



(2) Cable routing daigram with a built-in spindle motor (Models 2S, 3S, 30S, 40S)



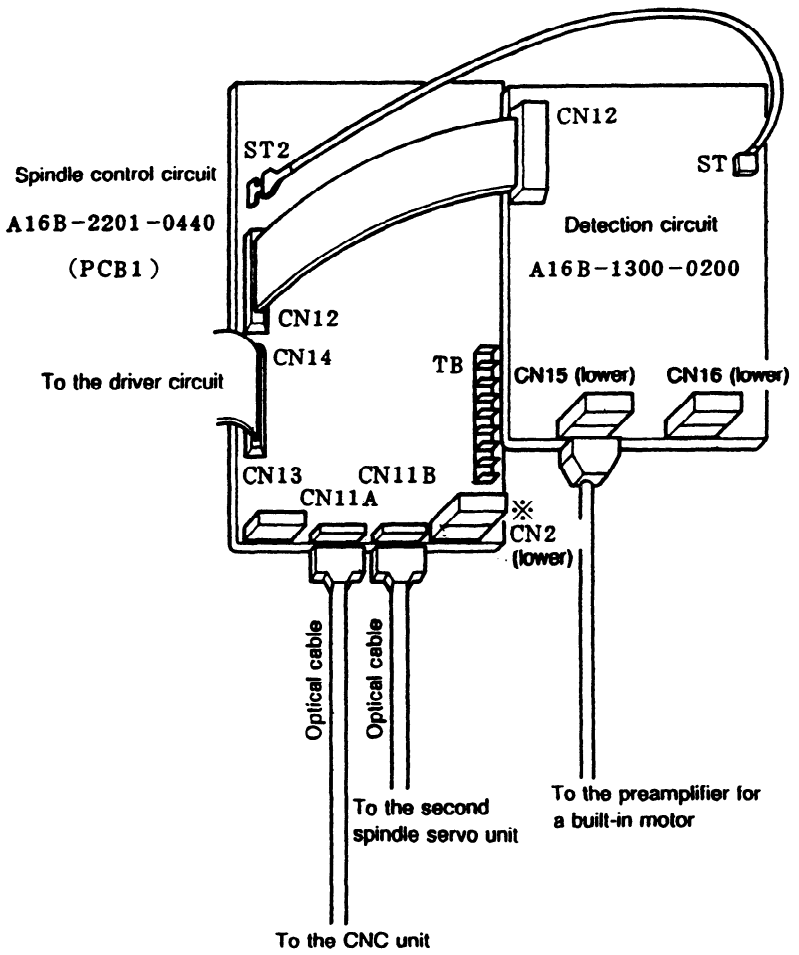
(3) Cable routing diagram (when the motor and the spindle are connected with a belt) for models 6S to 26S



Cable Routing Diagram
(When the Motor and the Spindle is Connected with a Belt)

(*1) Do not connect a cable with CN2.

(4) Cable routing diagram (for a built-in spindle motor) for models 6S to 26S



Cable Routing Diagram
(for a built-in spindle motor)

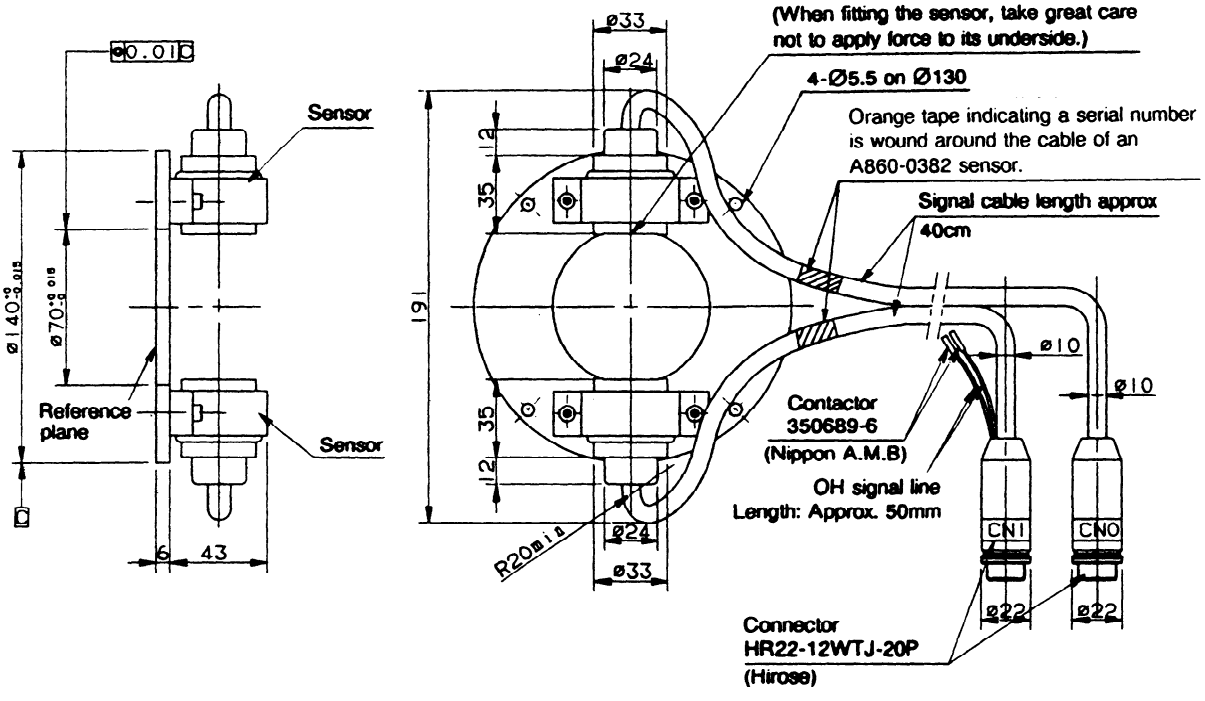
(*1) Do not connect a cable with CN2 and CN16.

6. DIMENSIONS

6.1 External Sensor Dimensions

Please refer to Subsection 6.1.4 for the preamplifier dimensions drawing.

6.1.1 Dimensions of sensors A860-0382-T121, T141



(Note) The OH signal line is not supplied with A860-0382-T121

Fig. 6.1.1 (a) Sensor assembly dimensions

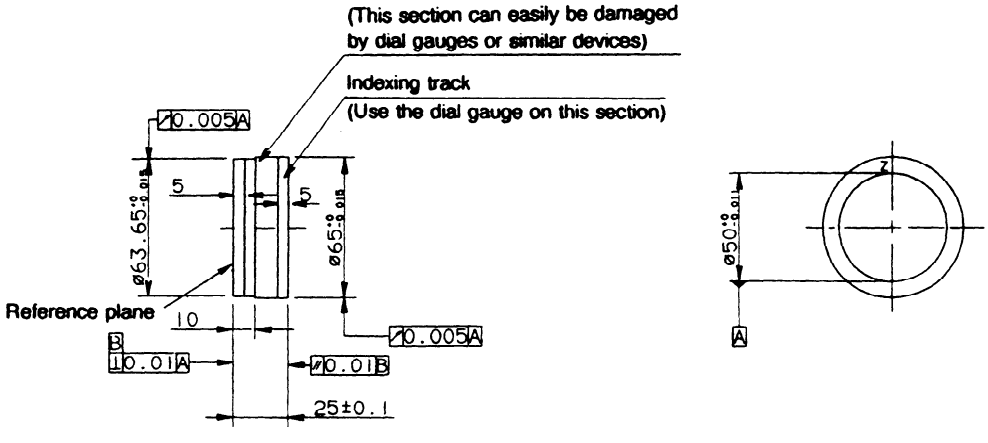
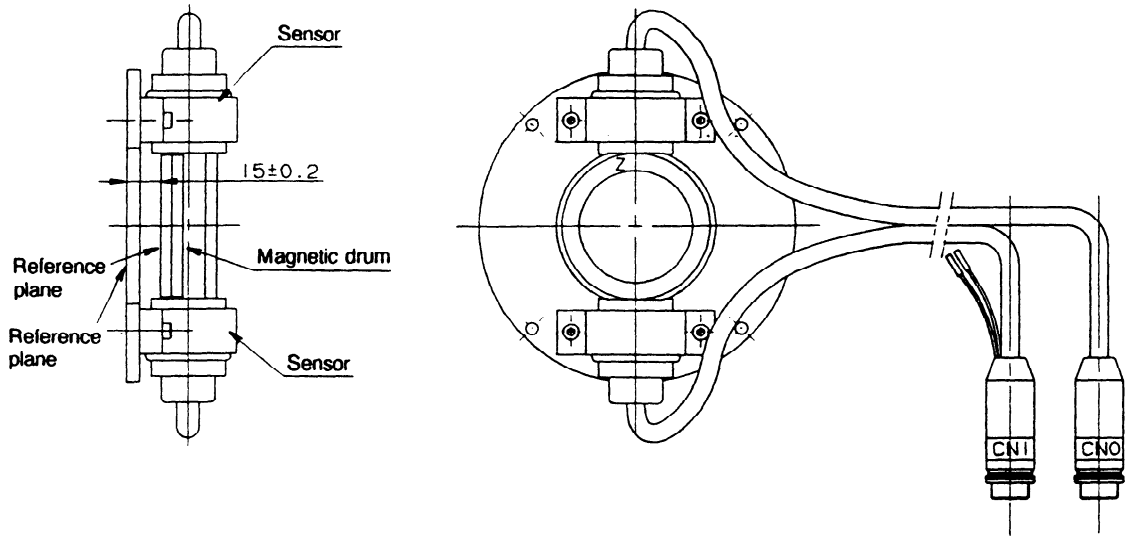
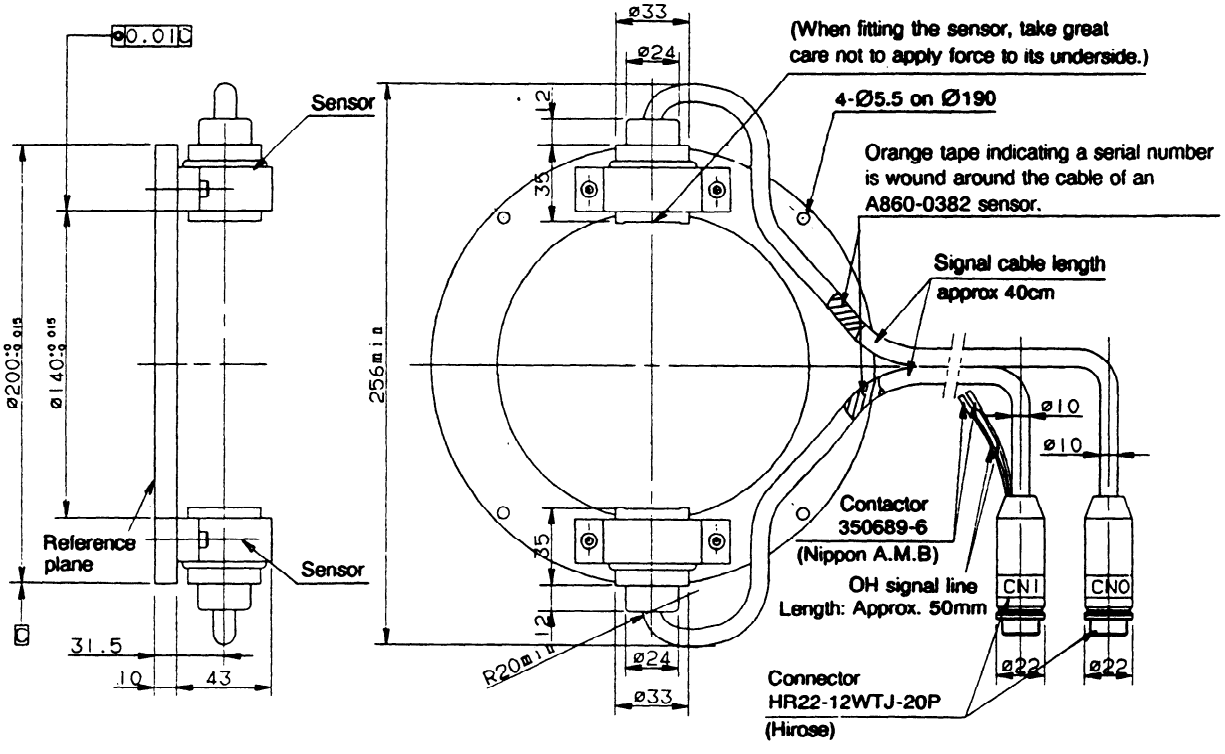


Fig. 6.1.1 (b) Magnetic drum dimensions



External sensor dimensions

6.1.2 Dimensions of sensors A860-0382-T123, T143



(Note) The OH signal line is not supplied with A860-0382-T123

Fig. 6.1.2 (a) Sensor assembly dimensions

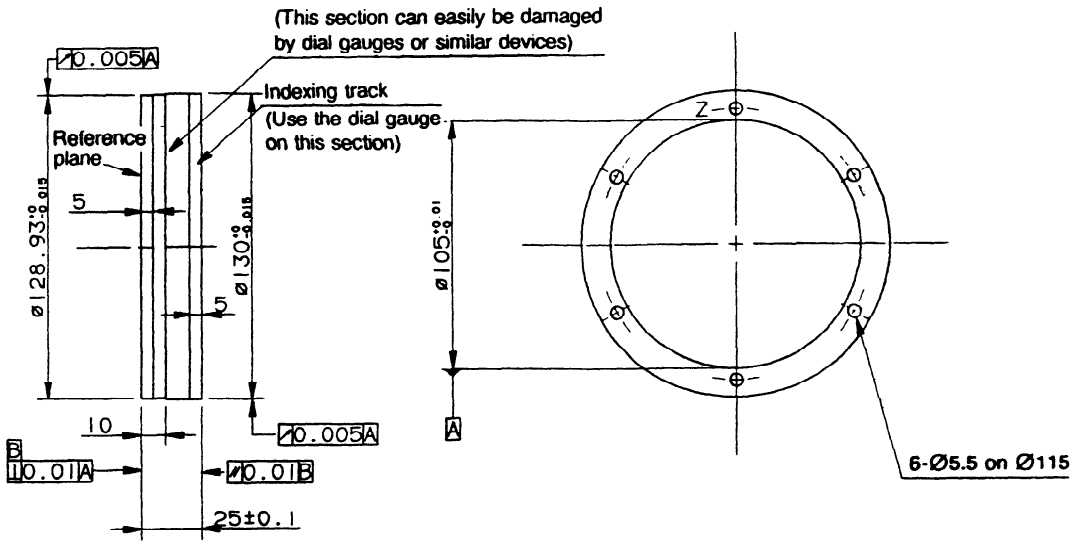


Fig. 6.1.2 (b) Magnetic drum dimensions

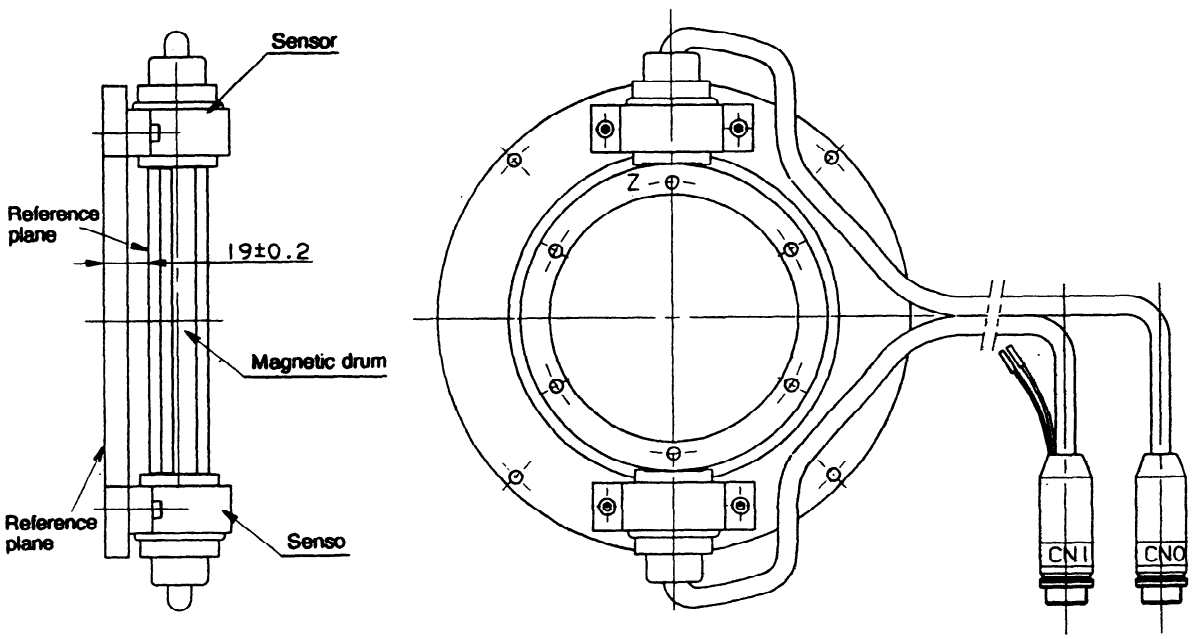
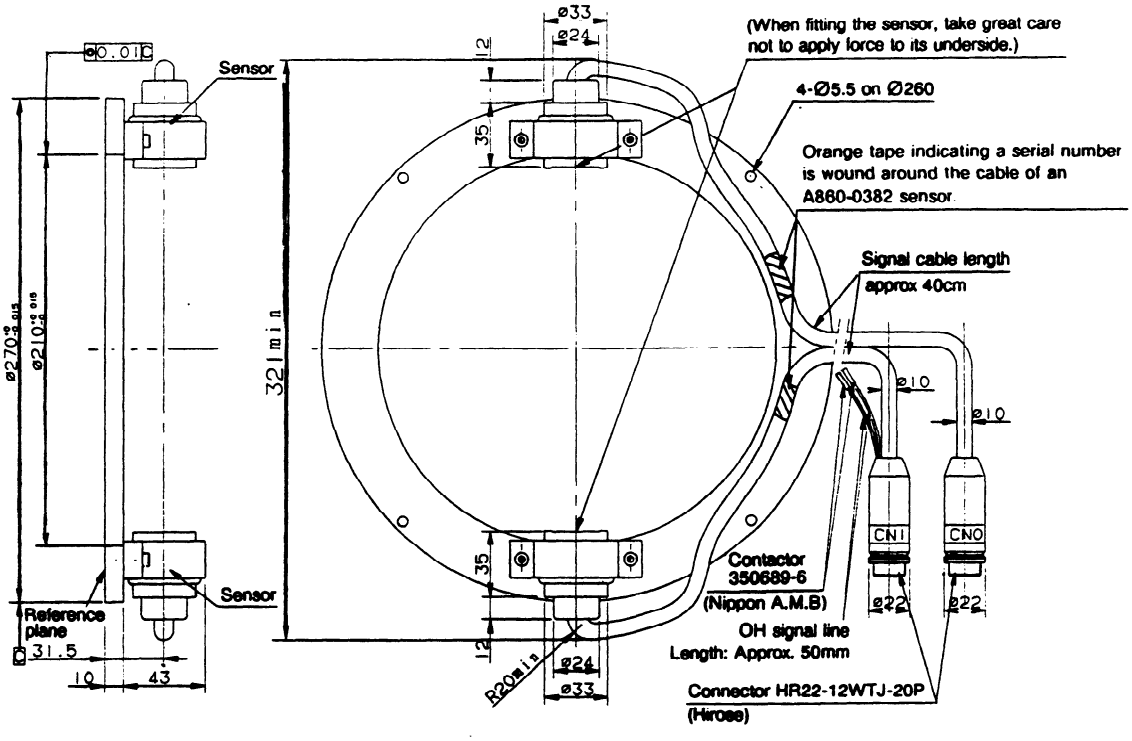


Fig. 6.1.2 (c) External sensor dimensions

6.1.3 Dimensions of sensors A860-0382-T124, T144



(Note) The OH signal line is not supplied with A860-0382-T124

Fig. 6.1.3 (a) Sensor assembly dimensions

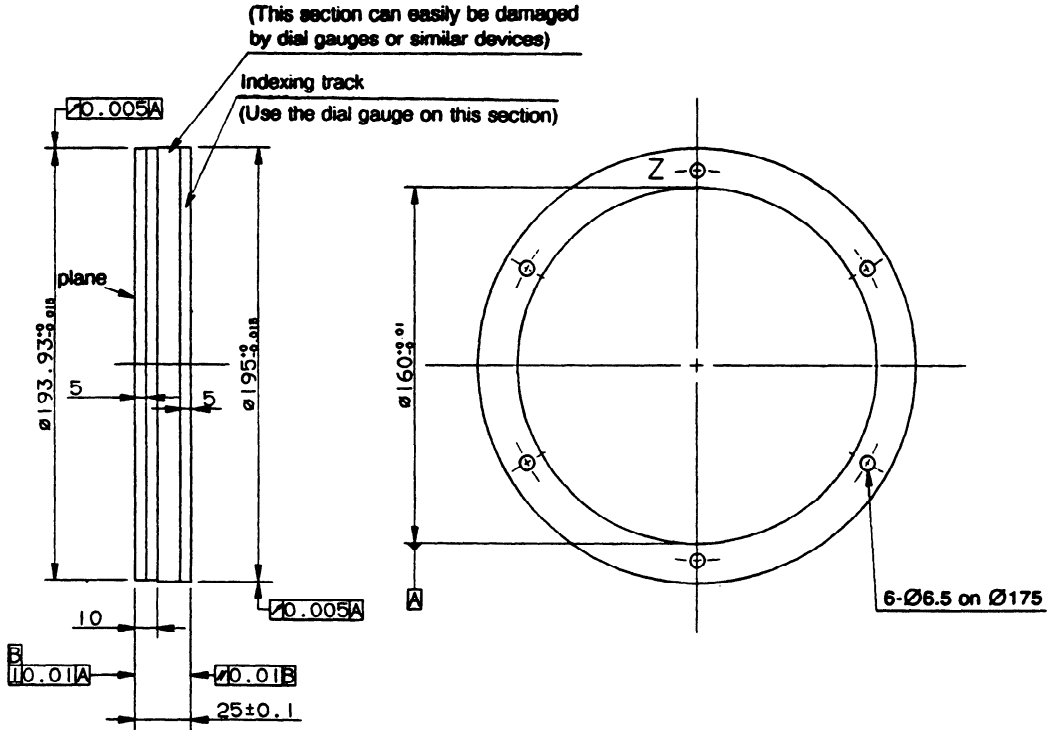


Fig. 6.1.3 (b) Magnetic drum dimensions

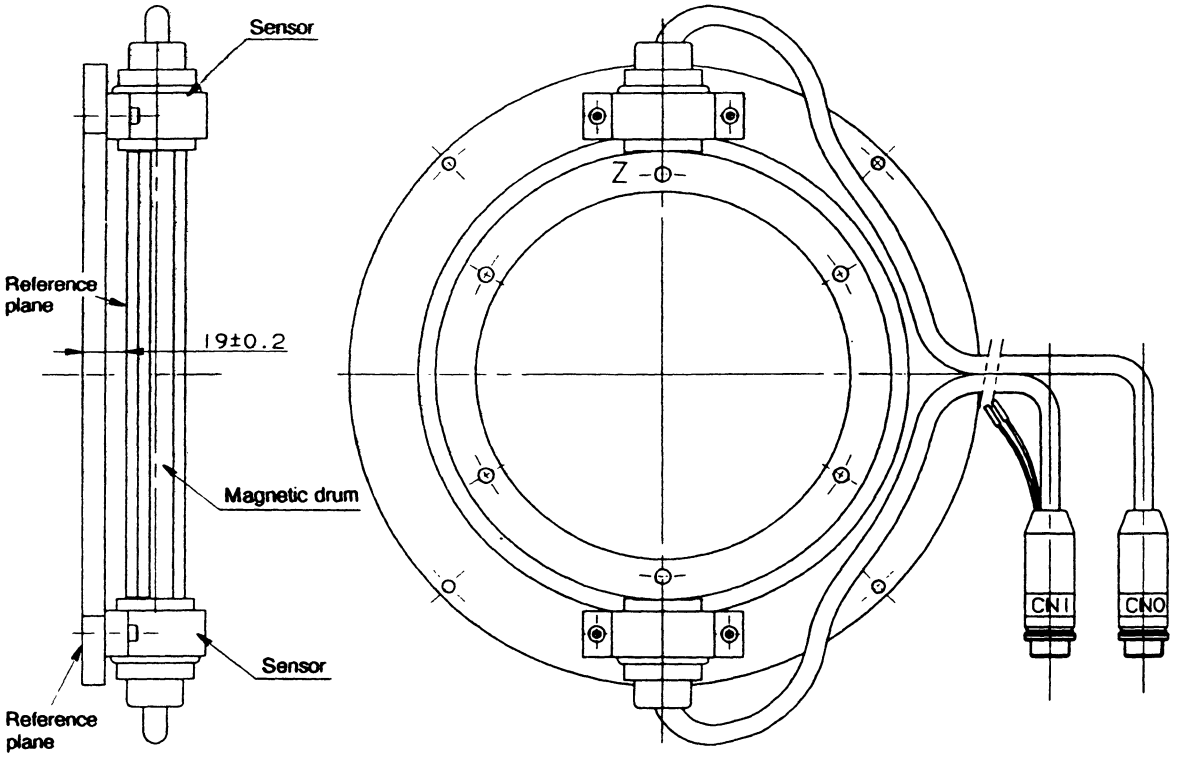


Fig. 6.1.3 (c) External sensor dimensions

(Note 1) The gap between the sensor and the drum is approximately 0.1mm. If the sensor mounting plate is fit to the machine, it is pre-adjusted to give a 0.1mm gap, so please do not remove the sensor.

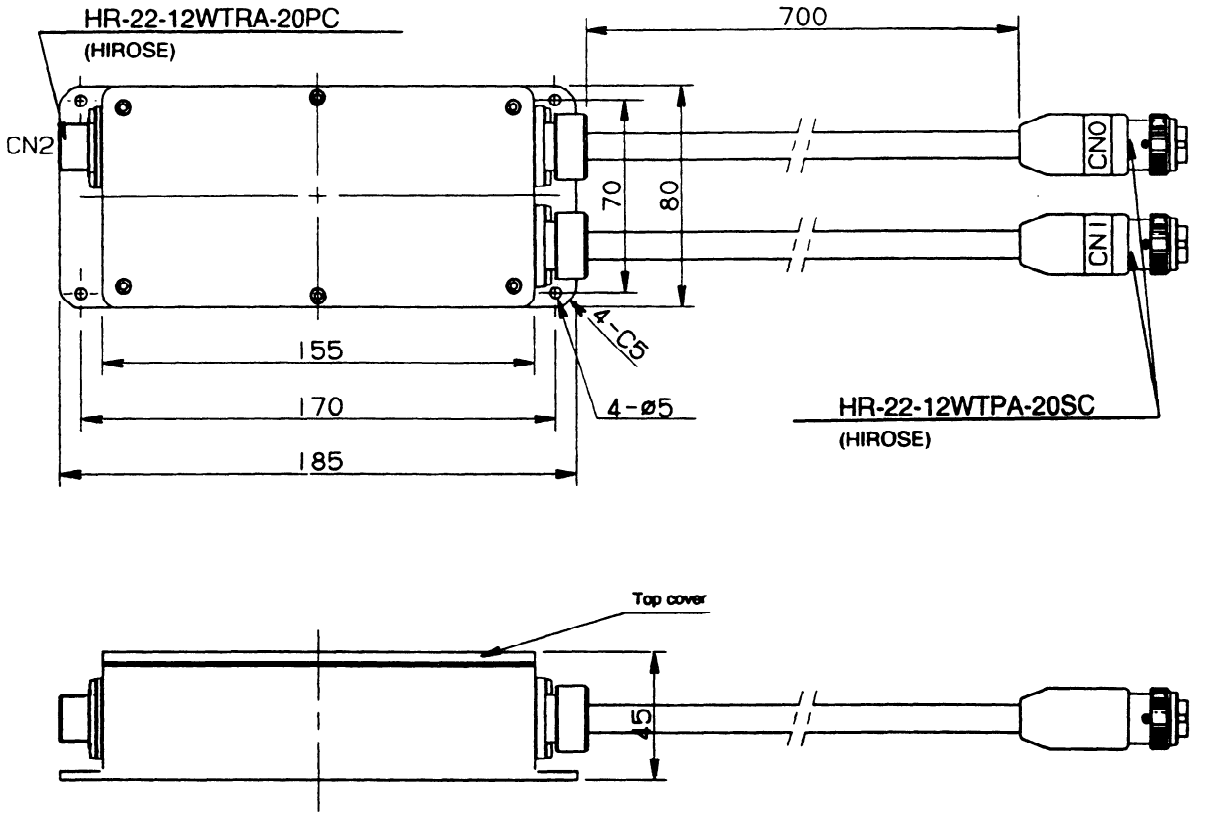
(Note 2) Take great care that the sensor is not directly exposed to cutting oil and cutting dust.

(Note 3) Maintenance should be performed separately for the sensor assembly and the drum.

(Note 4) Make sure that magnets and other items with strong magnetic fields are not brought close to the drum. If magnets such as a magnetized screwdriver and magnet stand come close to the drum it may become demagnetized and stop giving an output.

(Note 5) The reference plane of the drum is the underside of the surface marked "Z"

6.1.4 External preamplifier dimensions



(Note 1) The preamplifier box anti-drip standards are expected to meet IEC standard IP55. However, if cutting oil comes into direct contact with the preamplifier box so that the box is continually wet, the oil may penetrate into the box and cause damage. For this reason, care should be taken to set up the machine so that cutting oil does not fall directly onto the preamplifier box. (See Chapter 8.)

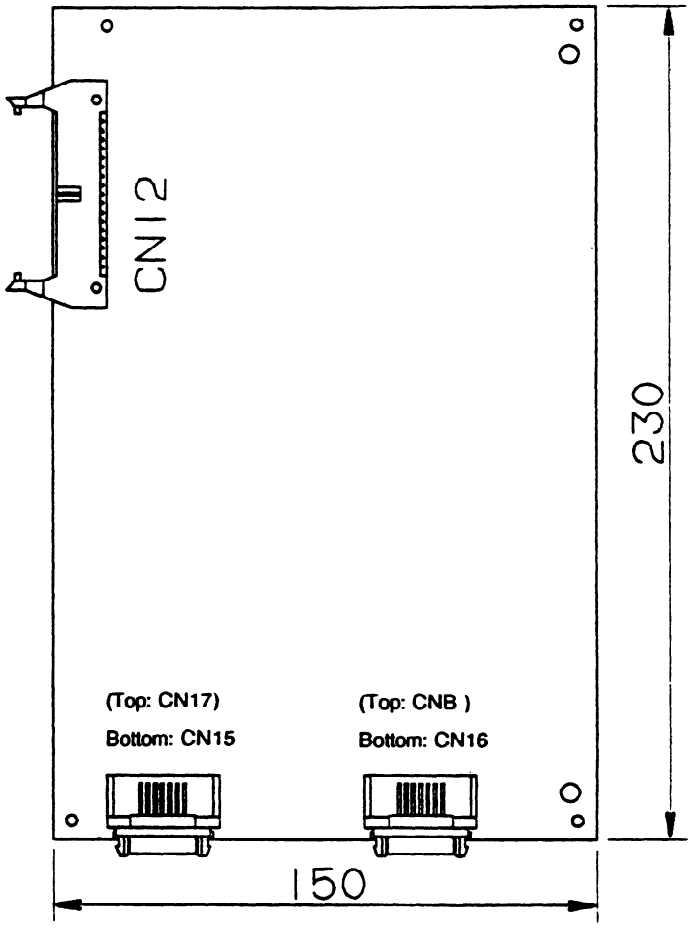
(Note 2) The preamplifier has been adjusted in advance so that the sensor and preamplifier match. Please use the same serial number for both. In normal circumstances, no further adjustment is required, but if the output waveform is outside the standard range, the preamplifier must be adjusted. To do this the top cover must be removed from the preamplifer. (See Chapter 7.)

The preamplifier needs to be adjusted if the sensor assembly or drum is replaced. For this reason, the preamplifier must be installed at a position where the top cover can be removed.

(Note 3) Because of restrictions on the output signal amplitude level, the preamplifier cable and sensor cable have a combined length of approximately 1.1m. The preamplifier must be fitted within 1.1m of the sensor.

(Note 4) Vibration affecting the preamplifier box must not exceed 1G.

6.2 Sensor Circuit Dimensions



The detection circuit is mounted on top of the serial interface S series spindle servo unit.

The connectors are stacked on top of each other. Please use only the bottom connectors, CN15 and CN16.

Do not use CN17.

CNB can be used as an external output for the position encoder signal.

7. CHECKING OUTPUT WAVEFORM AND ADJUSTING THE PREAMPLIFIER

The preamplifier is adjusted before shipment, but it may require readjustment after it has been fitted to the machine. Use the method described below to check the output waveform. If it is outside the prescribed range, it will need to be adjusted.

The waveform should be checked after fitting the sensor and before fitting the pulley, draw bar, brake and similar equipment. Check the waveform with power supplied to the sensor and with the spindle and motor rotating at no more than 500 min^{-1}. If the detection circuit is being adjusted by itself, an external 5V power supply will be required. Connect the power supply between the 5V and OV check terminals and remove connector CN12.

The outline of adjustment is described below. Refer to the following pages for details in adjustment.

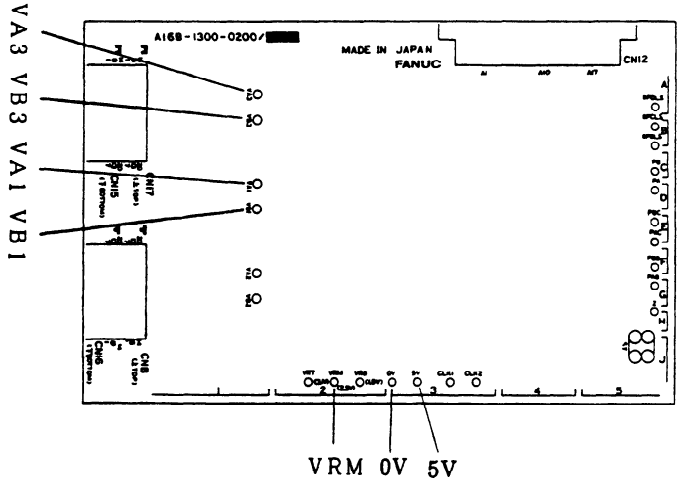


Fig.7 Check terminals on the detection circuit board

Table.7 Signals requiring waveform checking or adjustment

	C axis control signal	Position encoder signal (speed control signal)	Full rotation signal
Spindle sensor (position sensor)	VA1 VB1	VA3 VB3	Z
Measuring apparatus for waveform measurements	• Measure amplitude with an oscilloscope • Measure offset with an oscilloscope		Measure offset with an oscilloscope
Location of check terminals for observing waveform	On detection circuit board (See diagram above)		Z is on the preamplifier circuit board
Adjustment method	Using the adjuster on the preamplifier circuit board		

(Note) Prepare an oscilloscope with the X-Y function.

7.1 Spindle Sensor Preamplifier Adjustment Method

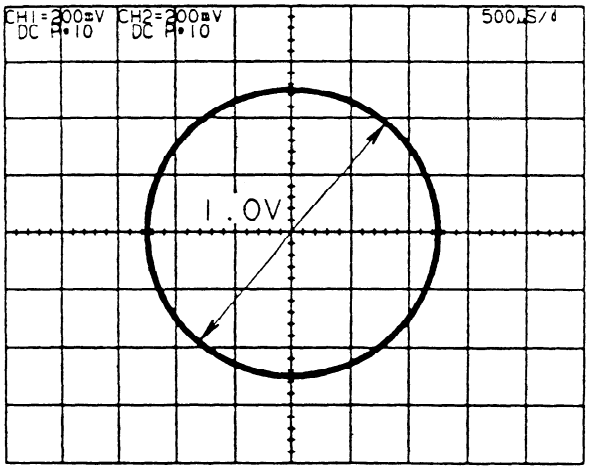
(1) Adjusting the C-axis control signal (position signal)

Oscilloscope connection	Oscilloscope setting
X probe : To be connected to the VA1 terminal Y probe : To be connected to the VB1 terminal. Probe GND: To be connected to the VRM terminal	X probe : 0.2 VDC/div Y probe : 0.2 VDC/div Mode : X-Y Sweep rate : 500 μs/div

(Note) Be sure to make a 0-V adjustment before starting a measurement.

When the oscilloscope is connected and set as indicated above, turn the motor manually or at a speed not higher than 500 min^{-1} to check that a satisfactory Lissajous waveform is observed.

Fig. 1 shows an example of a satisfactory waveform. Fig. 2 shows an example of an unsatisfactory waveform.



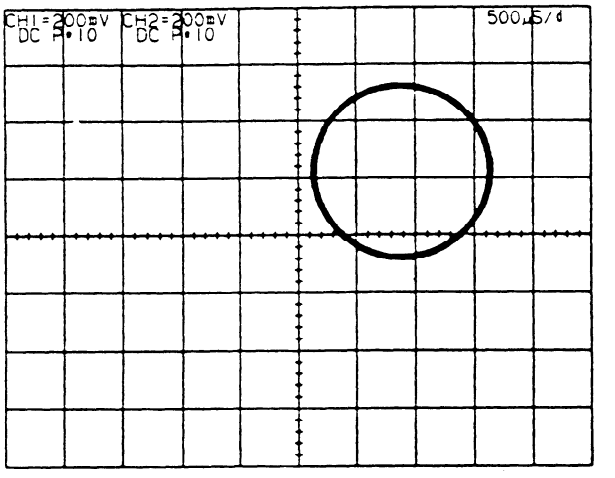


Fig. 1 Example of a Satisfactory Waveform Fig. 2 Example of an Unsatisfactory Waveform

For adjustment, turn the controls (indicated in the tables below) on the preamplifier until the diameter of the Lissajous waveform (circle) measures about 1.0 V on the oscilloscope scale, and the center of the Lissajous waveform is at the center of the oscilloscope screen.

(a) Adjusting the X- and Y-axis intercepts of a Lissajous waveform (output gain adjustment)
For adjustment, turn controls A1G and B1G on the preamplifier.

Allowable range of waveform intercepts	0.8V - 1.0V
Control A1G	Changes the distance between the X-axis intercepts of the wave form.
Control B1G	Changes the distance between the Y-axis intercepts of the waveform.

For the locations of controls on the preamplifier, see Fig. 6.

(b) Adjusting the position of a Lissajous waveform (offset adjustment)
For adjustment, turn controls A10 and B10 on the preamplifier.

Allowable range of waveform center position	± 10 mV along the X-axis and Y-axis
Control A10	Shifts the waveform along the X-axis.
Control B10	Shifts the waveform along the Y-axis.

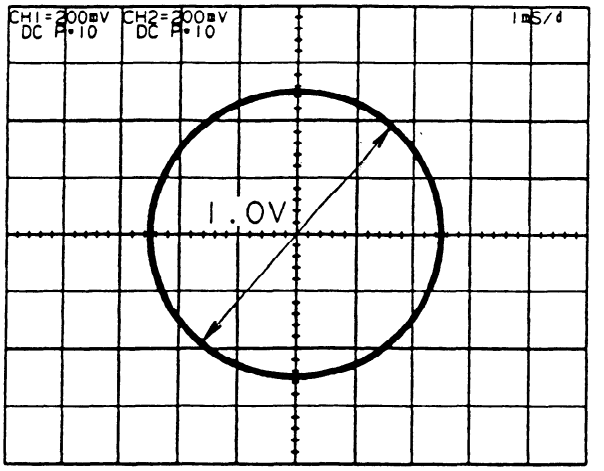
For the locations of the controls on the preamplifier, see Fig. 6.

(2) Adjusting the position coder signal

Oscilloscope connection	Oscilloscope setting
X probe : To be connected to the VA3 terminal Y probe : To be connected to the VB3 terminal. Probe GND: To be connected to the VRM terminal	X probe : 0.2 VDC/div Y probe : 0.2 VDC/div Mode : X-Y Sweep rate : 1 ms/div

(Note) Be sure to make a 0-V adjustment before starting a measurement.

When the oscilloscope is connected and set as indicated above, turn the motor manually or at a speed not higher than 500 min^{-1} to check that a satisfactory Lissajous waveform is observed.
Fig. 3 shows an example of a satisfactory waveform. Fig. 4 shows an example of an unsatisfactory waveform.



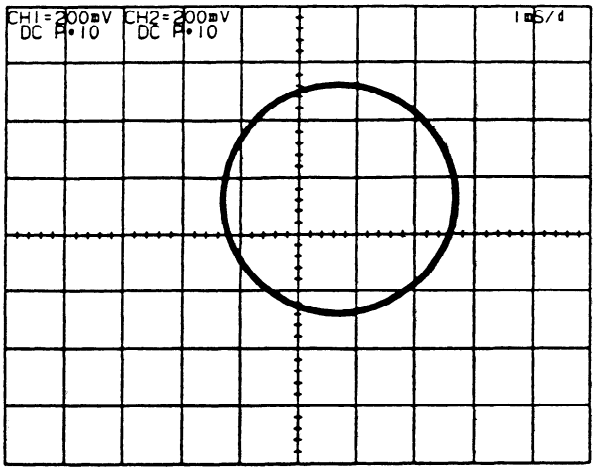


Fig. 3 Example of a Satisfactory Waveform Fig. 4 Example of an Unsatisfactory Waveform

For adjustment, turn the controls (indicated in the tables below) on the preamplifier until the diameter of the Lissajous waveform (circle) is about 1.0 V, and the center of the Lissajous waveform is at the center of the oscilloscope screen.

(a) Adjusting the X- and Y-axis intercepts of a Lissajous waveform (output gain adjustment)
For adjustment, turn controls A3G and B3G on the preamplifier.

Allowable range of waveform intercepts	0.8V - 1.0V
Control A3G	Changes the distance between the X-axis intercepts of the waveform.
Control B3G	Changes the distance between the Y-axis intercepts of the waveform.

For the locations of controls on the preamplifier, see Fig. 6.

(b) Adjusting the position of a Lissajous waveform (offset adjustment)
For adjustment, turn controls A30 and B30 on the preamplifier.

Allowable range of waveform center position	+30 mV in the X-axis and Y-axis directions
Control A30	Shifts the waveform along the X-axis.
Control B30	Shifts the waveform along the Y-axis.

For the locations of the controls on the preamplifier, see Fig. 6.

(3) Adjusting the one-rotation signal

Oscilloscope connection	Oscilloscope setting
X probe : To be connected to check terminal Z on the preamplifier. Probe GND: To be connected to the VRM terminal	X probe : 0.2 VDC/div Sweep rate : 5 ms/div

(Note) Be sure to make a 0-V adjustment before starting a measurement.

When the oscilloscope is connected and set as indicated above, turn the motor manually or at a speed not higher than 500 min^{-1} to check that a satisfactory waveform is observed. The one-rotation signal consists of a single pulse. So, set a trigger to capture the signal.
Fig. 5 shows an example of a satisfactory waveform.

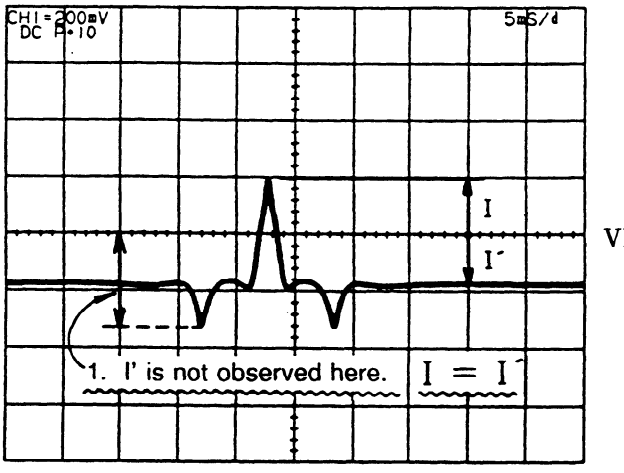


Fig. 5 Example of a Satisfactory Waveform

When the output waveform is not observed at the position shown in Fig. 5, turn the control on the preamplifier to adjust the position (offset).

Control Z0	Shift the position along the Y-axis.

For the location of the control on the preamplifier, see Fig. 6.

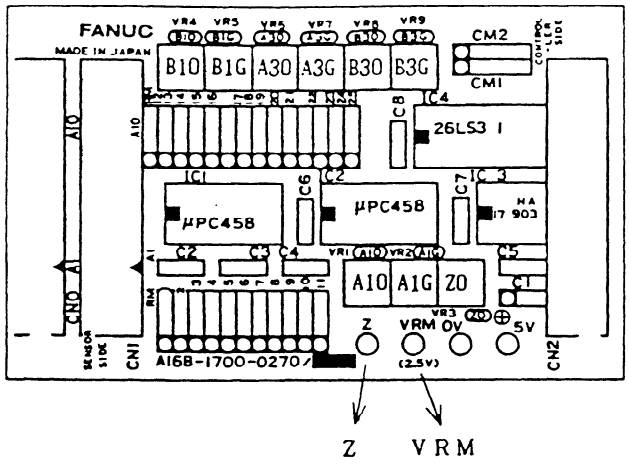
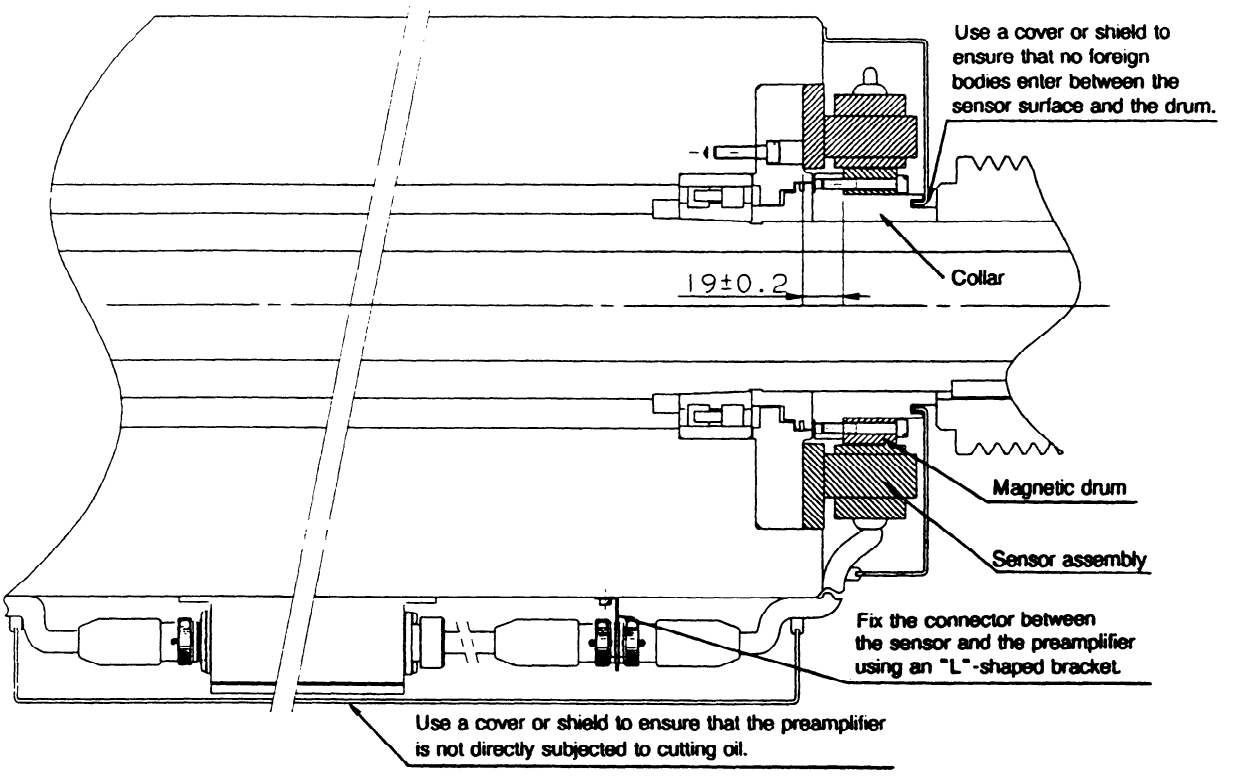


Fig. 6 Printed Circuit Board of the Preamplifier

7.2 Spindle Motor Built-in Sensor

The spindle motor with a built-in sensor is shipped with each signal adjusted, so use the sensor without modification.

8. SENSOR AND PREAMPLIFIER FITTING DIAGRAMS



9. SENSOR FITTING PROCEDURE

Use the procedure described below to fit the sensor to the procedure.

① Use a dial gauge to measure the squareness between the spindle and the machine side fitting surface for fitting the sensor mounting plate. Check that squareness does not exceed 20μm. If the fitting surface is tapered, the precision cannot be confirmed with a dial gauge, but this may also be a cause of problems for the sensor. Make sure that the maximum squareness of 20μm is taken into account when machining.

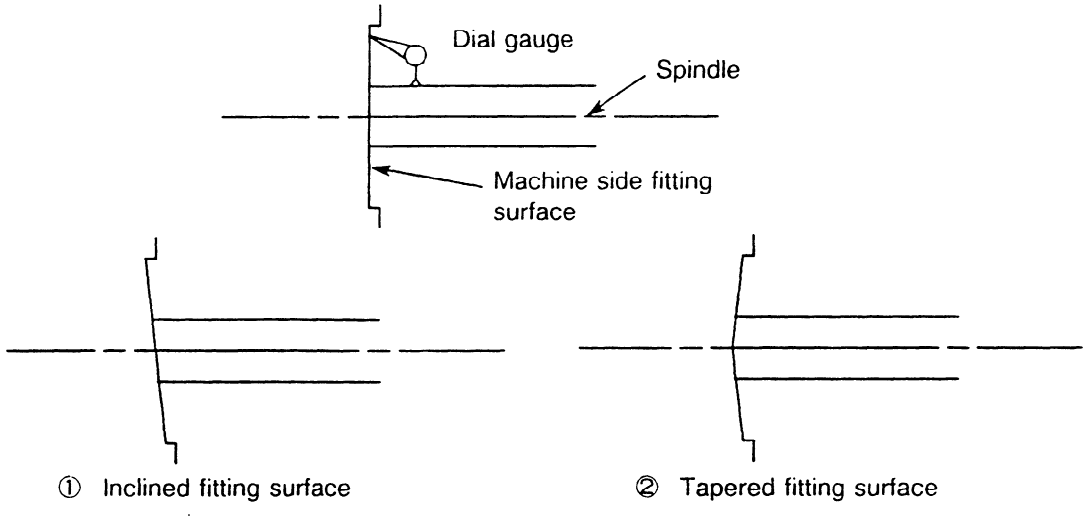
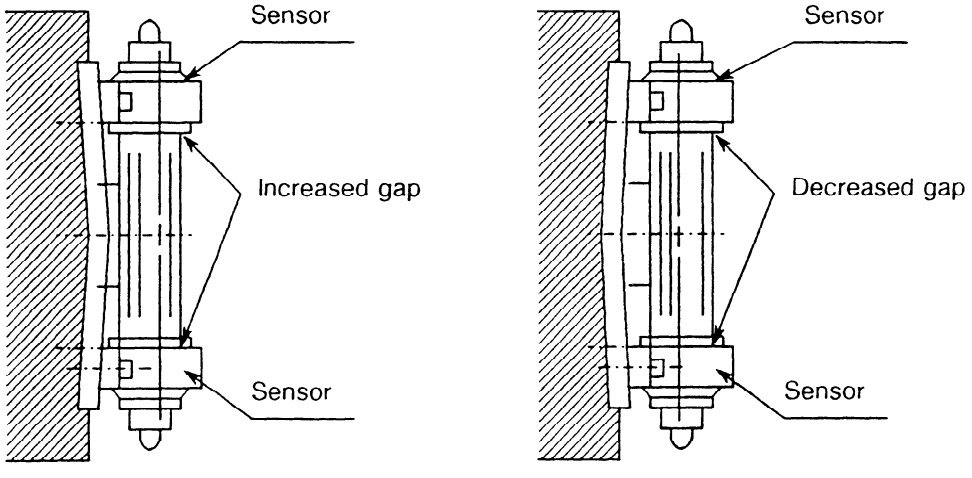


Fig. 9 (a) Problems of fitting surface

(Note) The fitting surface on the machine for attaching a sensor mounting plate must be perpendicular to the spindle. Otherwise, when the sensor mounting plate is attached with screws, the sensor can tilt, increasing or decreasing the gap between the sensor and magnetic drum. As the result, a non-sinusoidal waveform is output, or the amplitude of an output waveform is reduced. Ensure that the fitting surface is within 20μm of being perpendicular to the spindle axis.



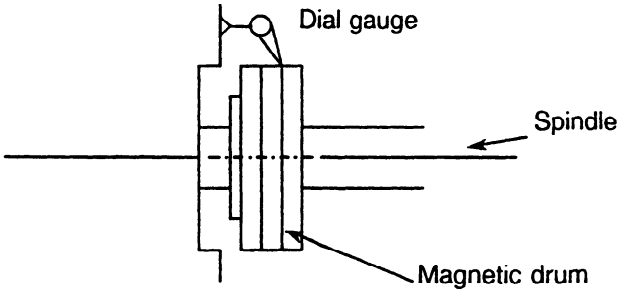
Trouble that occurs when the fitting surface on the machine is tilted

② Fitting the magnetic drum onto the spindle

Detector used	A860-0382-T121 A860-0382-T141	A860-0382-T123 A860-0382-T143 A860-0382-T124 A860-0382-T144
Drum fitting method	When fitting the drum, use shrink fit or sleeve cooling fit (Chapter 8). Be careful not to raise the temperature of the drum above 100 C, which is the maximum allowable temperature of the drum.	Screw the drum using the holes of 6- 5.5 on it. To align the drum, loosely tighten the screws.
Drum fitting method	Fit the drum onto the spindle so that the drum reference plane faces the nose of the spindle. The drum reference plane is the side opposite to the plane where Z is printed.	

③ Adjustment for alignment (to suppress the vibration of the drum within 5 μm)
Measure the vibration of the circumference of the drum with a dial gauge, and make an adjustment to suppress the vibration within 5 μm.
Upon completion of adjustment, secure the drum with the screws.

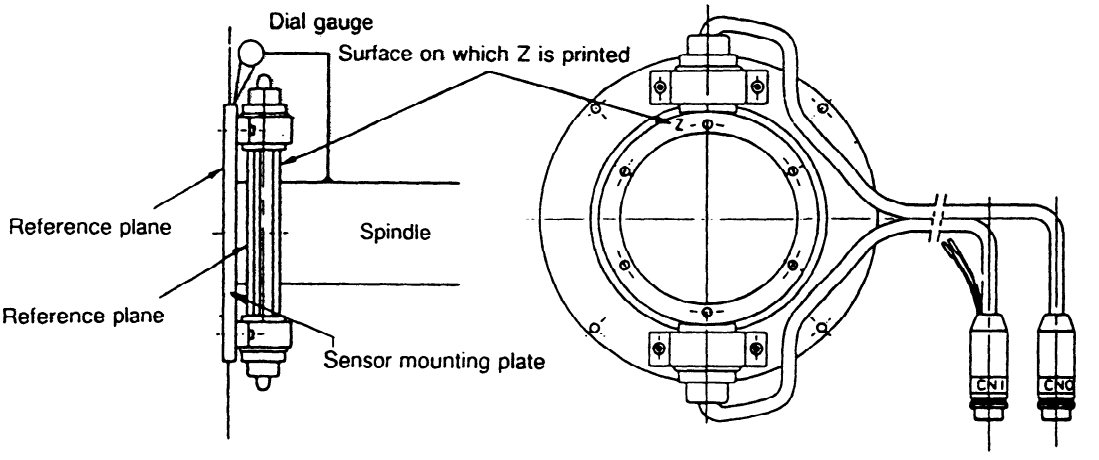
(Note) No adjustment for alignment is required for sensors A860-0382-T121 and A860-0382-T141.



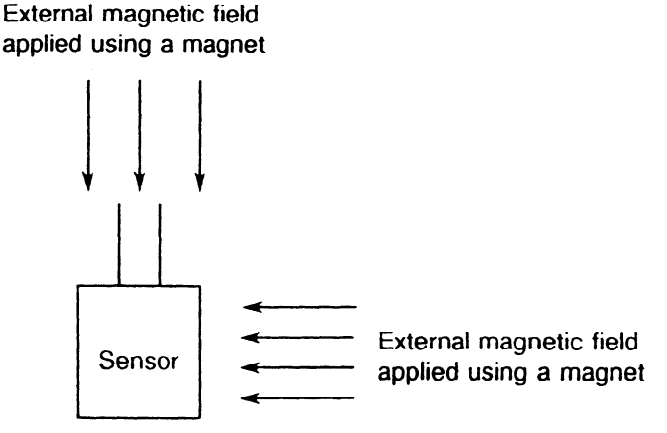
(Note) Be careful not to place a magnetic material such as a magnet near the magnetic drum. If a magnet, magnetized driver, magnet stand, or the like is placed near the magnetic drum, the drum can be demagnetized, and can no longer output waveforms of the sensor.

④ Mounting and adjusting sensors (to suppress the vibration within 20 μm)
Mount sensors so that the sensor reference plane and drum reference plane face the same direction. (See the figure below.)
Make an adjustment with a dial gauge so that the vibration of the faucet joint of the sensor mounting plate with respect to the spindle is within 20 μm. If the vibration exceeds this limit, a sensor may not operate normally.

(Note) Be sure to mount sensors after drum alignment. If drum alignment is performed after sensors are mounted, the drum interferes with the sensors, causing a failure.
(Note) Ensure that the fitting surface on the machine for attaching the sensor mounting plate is within 20 μm of being perpendicular to the spindle axis. Otherwise, a sensor can tilt, resulting in an abnormal output waveform.



(Note) Be careful not to expose the sensors to coolant and chips.
(Note) An experiment as shown below revealed that an external magnetic field of 20 gauss or more adversely affects the output waveform of the sensor. Be careful not to expose the sensors to such a magnetic field.



(Note) The gap required between a sensor and drum is about 0.1 mm. When a faucet joint is used for assembly, never remove the sensors from the sensor mounting plate because the gap is already adjusted for 0.1 mm.

(Note) Always handle a drum and sensors as a set. Do not replace a component of a set with another component even if both components have the same drawing number.
Replace the sensors and drum as a unit, especially when maintenance requires a component to be replaced. A preamplifier can be used only after an output signal adjustment is made. So, it is recommended that the associated preamplifiers are also replaced together with the sensors and drum.

XIV. HIGH-RESOLUTION POSITION CODER

1. GENERAL

The high-resolution position coder is an optical encoder which detects a C-axis contour control signal (1/360,000 rotation) and position coder signal. It is used in conjunction with the detection circuit mounted on the serial interface S-series spindle amplifier. Mounting of the high-resolution position coder is compatible with that of ordinary position coders.

The C-axis contour control function can be added without greatly changing the mechanism by mounting the high-resolution position coder instead of an ordinary position coder.

2. FEATURES

(1) Cs contour control can be performed easily
By using a motor in which the high-resolution magnetic pulse coder is incorporated, and by replacing the conventional position coder with the high-resolution position coder (which requires the same installation space as the conventional one), Cs contour control can be utilized without any large changes in the mechanism. The high-resolution position coder has the same functions as those of the conventional one.

(2) Compact and can be used in a severe environment
This compact position coder has the same basic structure as that of the conventional one. It is solid and can be used in severe conditions. (Protection grade: IP55)

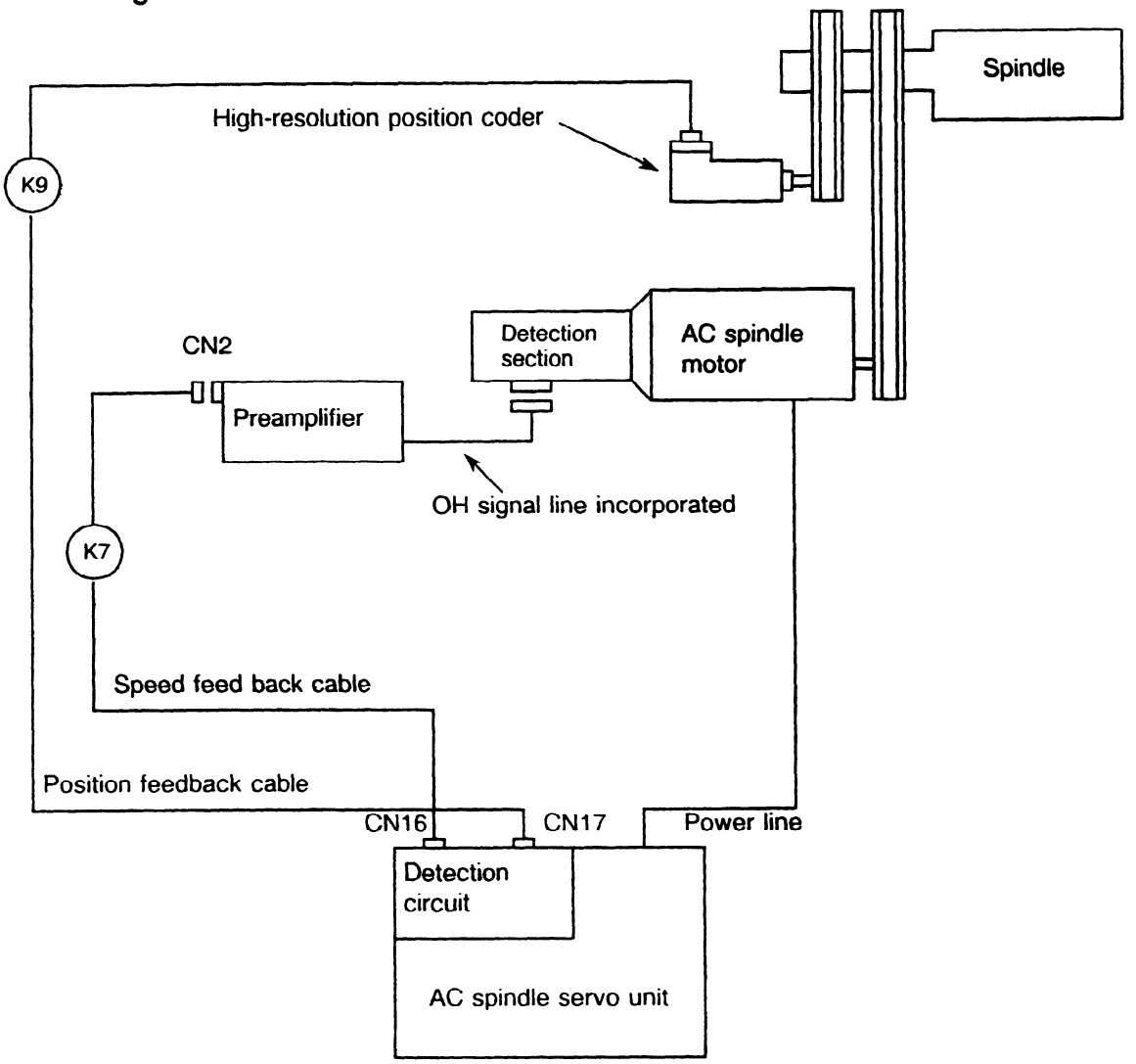
(3) It is impossible to use following option when high-resolution position coder detection circuit is used. The following optional circuits cannot be used together with the detection circuit for a high-resolution position coder.

Optional circuit unusable with detection circuit for a high resolution position coder	
Name	Specification drawing number
Spindle switching control circuit	A06B-6064-J701 A06B-6064-J702
Position coder signal input circuit	A06B-6064-J703
Built-in signal conversion circuit for a built-in sensor	A06B-6064-J704 A06B-6064-J706
Detection circuit for a high-resolution magnetic pulse coder	A06B-6064-J720 A06B-6064-J721 A06B-6064-J722 A06B-6064-J724 A06B-6064-J725 A06B-6064-J726

3. SYSTEM CONFIGURATION

The high-resolution position coder system consists of the high-resolution position coder, spindle motor with built-in high-resolution magnetic pulse coder, and detection circuit.

3.1 Configuration



3.2 Order Drawing Number

3.2.1 High-resolution position coder

Type	Item	Code No.	Remarks
Option	High-resolution position coder	A860-0319-T002	68 mm-square flange is used for mounting.

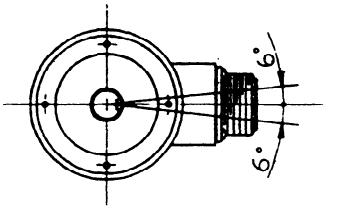
3.2.2 Detection circuit for the high-resolution position coder

Type	Item	Code No.	Remarks
Option	Detection circuit for the high-resolution position coder	A06B-6064-J705	Drawing No. of the printed circuit board: A16B-1300-0210

(Note) This circuit cannot be used for the spindle servo units in the conventional types of models 6S to 26S (A06B-6063-HXXX#HXXX).

4. SPECIFICATIONS

4.1 Electrical Specifications of High-resolution Position Coder System

Item	Specifications	
Power voltage	5V ± 5%	
Output signal	Cs contour control signal	A, B
	Position coder signal	A, B
	Single-rotation signal	Z
Number of output pulses	Cs contour control signal	90,000 pulses/rotation
	Position coder signal	1,024 pulses/rotation
Resolution	Cs contour control signal	1/360,000 rotation
	Position coder signal	1/4,096 rotation
Output position of single-rotation signal	When the shaft keyway faces the MS connector, a single-rotation signal is output between the angles of +6° and −6° with the reference line. Here, the center line of the MS connector is assumed to be the reference line.	

4.2 Mechanical Specifications of High-resolution Position Coder

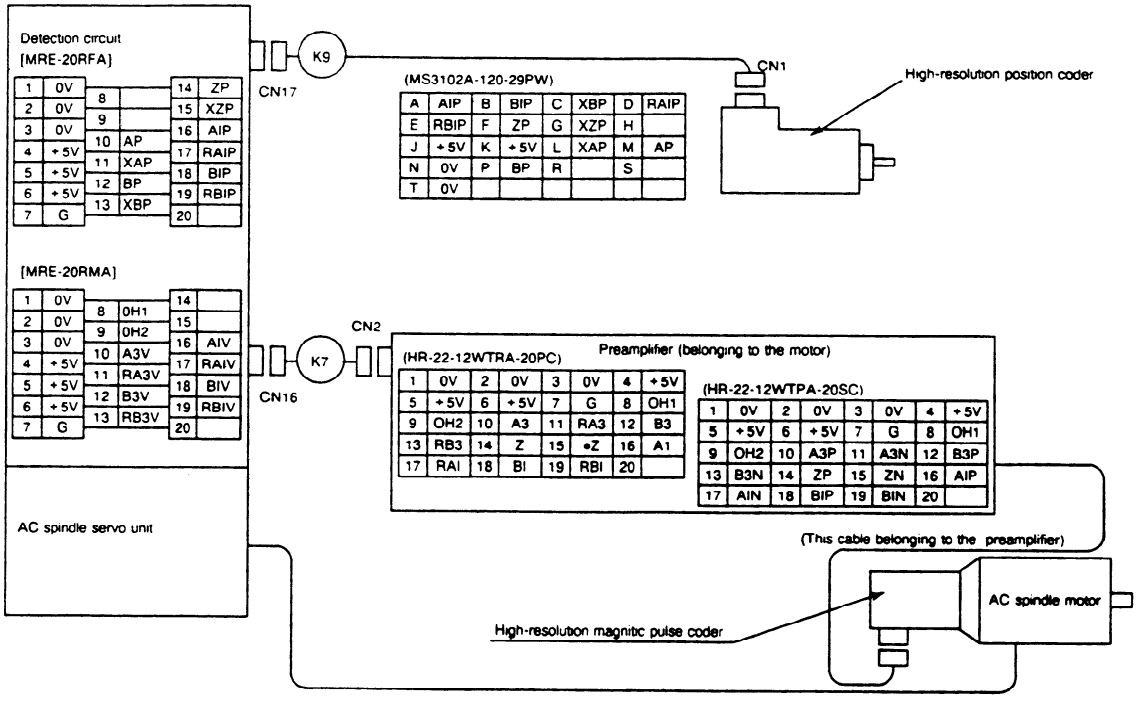
Item	Specifications		
Input shaft inertia	1×10^{-3} kg.cm.s^2 or less		
Input shaft starting torque	1000 g.cm or less		
Allowable load for input shaft	Radial load	Operating	10 kg
		Static	20 kg
	Thrust load	Operating	5 kg
		Static	10 kg
Input shaft run-out	0.02 mm or less (measured 15 mm from the mounting faucet)		
Run-out of the mounting fit against the axis	0.035 mm or less		
Run-out of the mounting surface against the axis	0.05 mm or less (measured R30 mm from the axis)		
Maximum allowable speed	8,000 min^{-1}		
Bearing life	20,000 hours or more at the maximum allowable speed when the allowable load at operation is loaded on the input shaft		
Structure	Dust-proof and drip-proof (about the level of IP55)		
Vibration resistance acceleration	10G (10 – 500 Hz)		
Weight	Approx. 1 kg		

4.3 Environmental Conditions

Item	Specifications
Applicable temperature range	0°C – 50°C
Humidity	95% RH or less

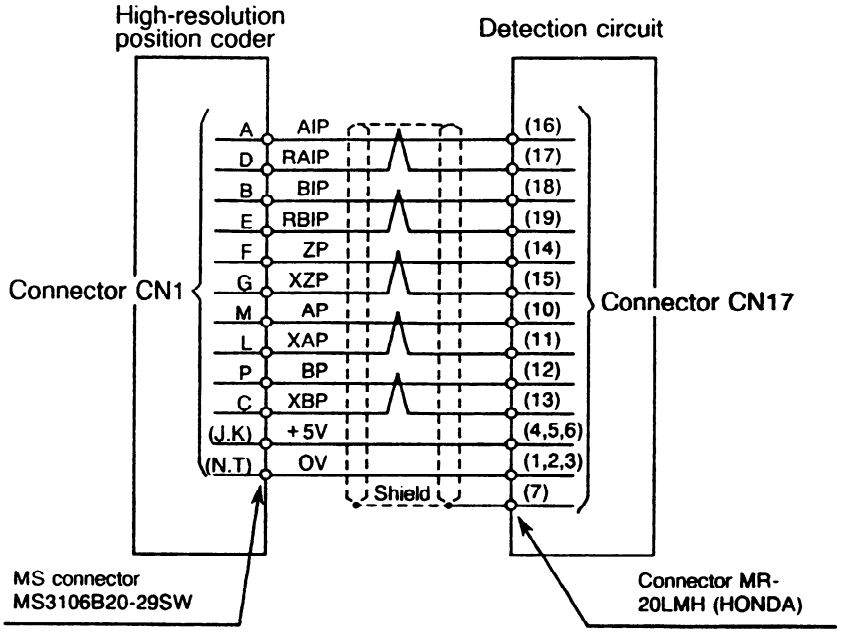
5. CONNECTION

5.1 Connection Diagram



(Note) Cable K7 is a speed control feedback cable (A06B-6063-K802) for the spindle motor with built-in high-resolution magnetic pulse coder. For details of cables, see Part VIII.

5.2 Details of Cable K9



Cable to be used (cable length: 14 m or less)

+5V, 0V: Six wires or more each having a cross-sectional area of at least 0.2mm^2

Other wires: Block-shielded pair cables having a cross-sectional area of at least 0.18 mm^2

Drawing numbers to be specified when cables are purchased from FANUC

A06B-6050-K861 (MS connector, straight type)

Cable length: 14 m

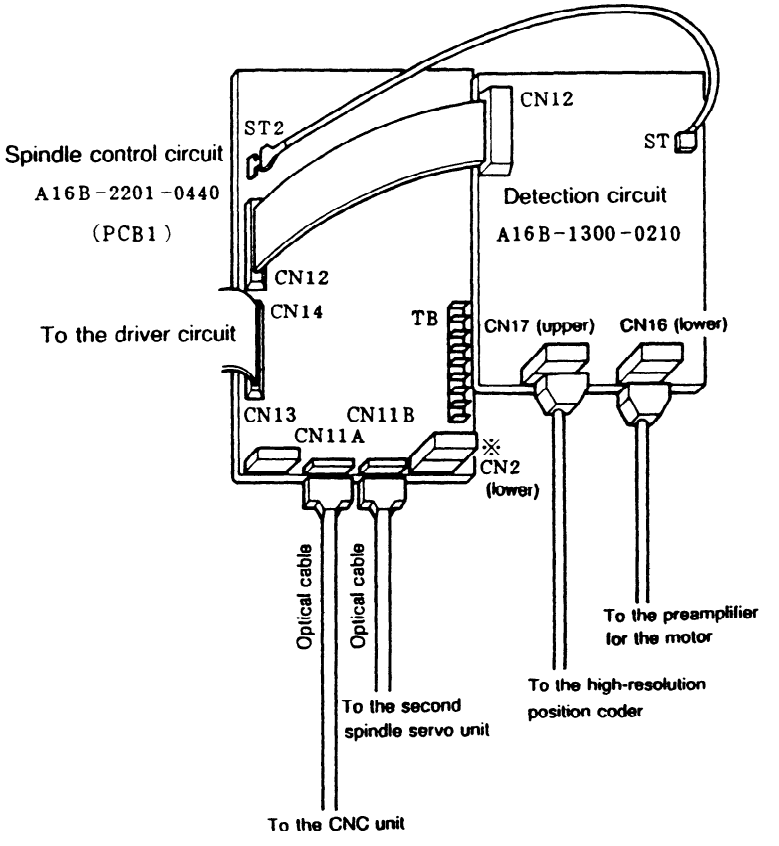
A06B-6050-K862 (MS connector, elbow type)

Cable length: 14 m

5.3 Cable Routing Diagram

See Appendix 1, "Cable Specifications."

Cable routing diagram when the Cs contour control function is used (when the motor and the spindle are connected with a belt)



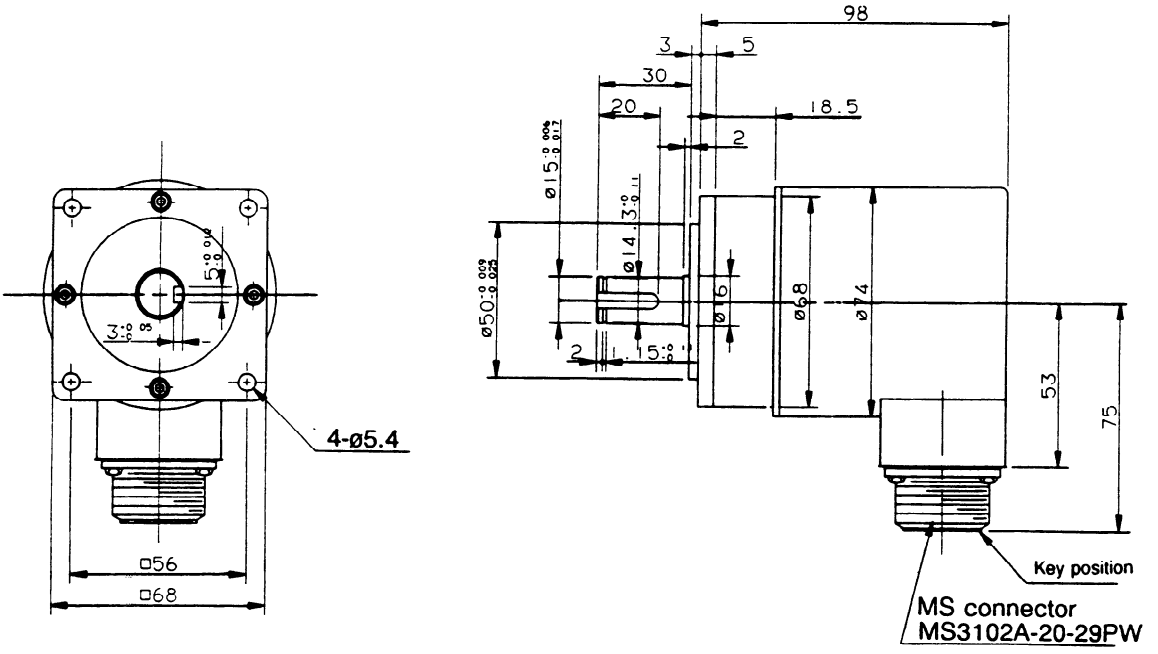
Cable Routing Diagram - When the High-Resolution Position Coder is Provided
(when the motor and spindle are connected with a belt)

(*1) Do not connect a cable to CN2.

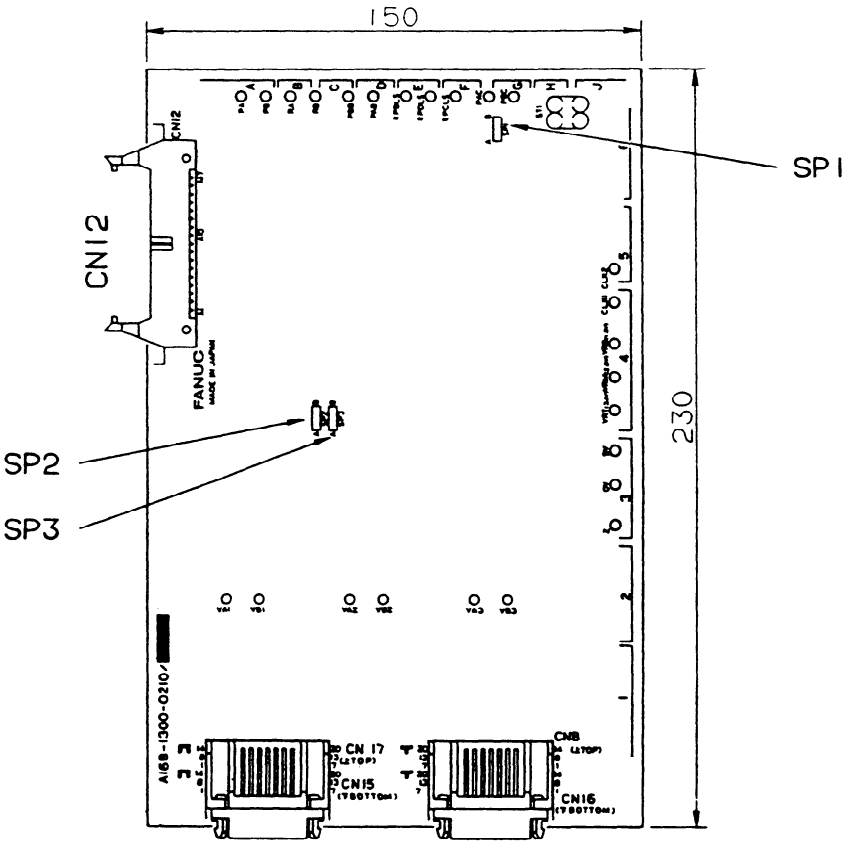
6. SHAPE

6.1 External Dimensions of High-resolution Position Coder

External Dimensions of A860-0319-T002 (mounting flange □68)



6.2 External Dimensions of Detection Circuit



Upper connector CN17	Upper connector CNB
Lower connector CN15	Lower connector CN16

(Note 1) The detection circuit is mounted on the serial interface S-series/P-series spindle amplifier.

(Note 2) Use CNB when outputting a position coder signal to the outside.

(Note 3) Set the setting pins on the circuit board as shown below:

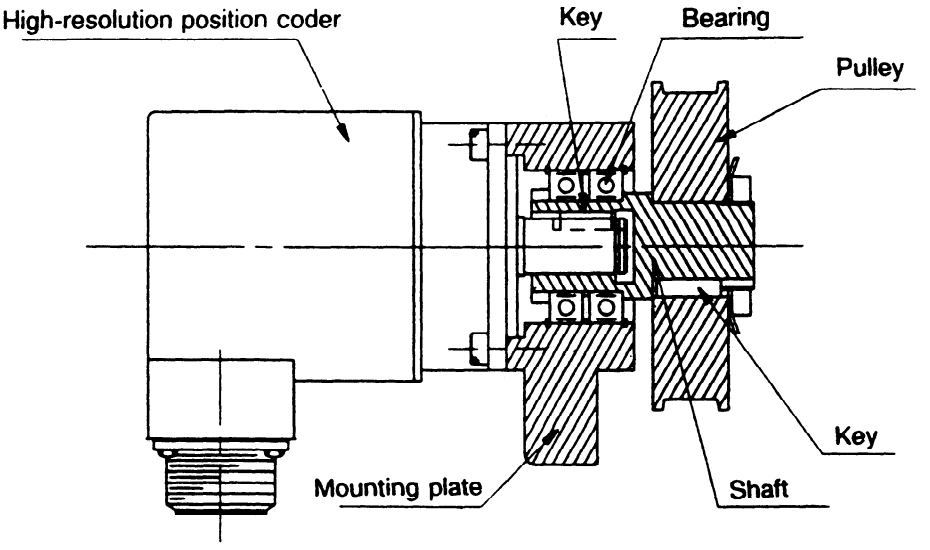
SP1	B
SP2	A
SP3	A

7. INSTALLATION CONDITION AND CAUTIONS

7.1 High-resolution Position Coder

7.1.1 How to connect the position coder

The high-resolution position coder can be connected to the spindle in one of the following methods.



(1) Connect the position coder to the rear of the spindle with a flexible joint. In this method, the positioning precision by the position coder is high because spindle rotations are transmitted to the position coder accurately. However, since the place which the position coder is installed in is limited, mechanical modification may be required.

(2) Engage the shaft for the pulley with the position coder, and hold the shaft with a double bearing as shown in the following figure. Connect the pulley of the position coder to the pulley of the spindle with a timing belt.
This method is generally used to connect an ordinary position coder to the spindle. When adopting this method, note the following:

① The circular or vertical play between the pulley shaft and the position coder shaft may fret the position coder shaft or cause the key to shift. It affects the positioning precision by the position coder. Therefore, determine the tolerance not to allow any play between these shafts, or between the key and keyway.

② The outside diameter of the position coder pulley could be eccentric against the axis of the position coder shaft. Alternatively, the outside diameter of the pulley built into the shaft could be eccentric against the axis of the shaft. The size of the rotation error between the shaft rotation and position coder rotation is in proportion to the eccentricity. The rotation error affects the positioning precision by the position coder. Therefore, minimize the eccentricity.

7.1.2 Impact

Since the high-resolution position coder is a precision detector, be careful not to subject it to impact.

7.1.3 Atmosphere

The protecting format of the high-resolution position coder satisfies IP55. This standard, however, designates the performance only for a short period. The surface of the high-resolution position coder may always be wet with coolant or lubricating oil. Be careful to prevent this, and use a cover if necessary.

7.2 Detection Circuit

See Part XIII for the installation conditions and notes on the use of the detection circuit.

7.3 Checking and Adjusting the Waveform of the High-resolution Magnetic Pulse Coder Which is Built in the AC Spindle Motor

See Part XIII for how to check and adjust the waveform on the detection circuit.

XV. SPEED RANGE SWITCHING CONTROL

1. GENERAL

Speed range control conducts control of speed range switching in one motor (motor designed specifically for speed range control) using the FANUC AC spindle servo unit SERIAL INTERFACE S series.

2. CONFIGURATION AND ORDER DRAWING NUMBER

2.1 Configuration

The following items are needed in addition to the FANUC AC spindle servo unit S series.

(1) Speed range switching control software(option)

(2) Relay circuit (including electromagnetic and drive relay)

(3) Switching signal from PMC

Configuration of the components is shown in Fig. 2.1.

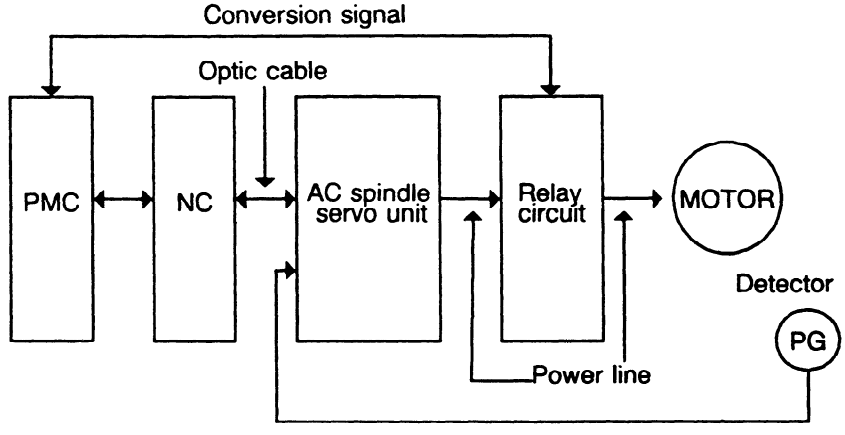


Fig. 2.1 System configuration

The machine tool manufacturer is required to provide the relay circuit and the swithing signal from the PMC.

2.2 Order Specifications

(1) AC spindle servo unit
Refer to Ⅶ-3.2.

(2) Speed range switching control software (CNC software option)

Series 15M/T	: A02B-0094-J732
Series 0MC	: A02B-0099-J984
Series 0TC, TT	: A02B-0098-J984
Series 16M	: A02B-0121-J854
Series 16T, TT	: A02B-0120-J854
Power Mate-MODEL A	: A02B-0118-J804
Power Mate-MODEL B	: A02B-0122-J804

3. SPECIFICATIONS

In order to conduct speed range switching control, the AC spindle servo unit S series, speed range switchingcontrol software and a relay circuit are required.
See Part Ⅶ for details of the AC spindle unit.

(Note) Precautions related to specifications when the speed range switching control circuit is provided with the AC spindle servo unit S series

(1) As the speed detecting signal (SDTA) is used for switching speed detection, it cannot be used for gear conversion speed detection, etc.

(2) The spindle orientation circuit option can be used even when the speed range switching control circuit is included.

(3) The input signals from PMC to CNC include the signal RCHA as a power-line status check signal. And, the function that the status of the electromagnetic contactors both on the high-speed side and on the low-speed side can be inputted was added, because the status of the power-line can be checked more certainly on the spindle side.
To check the status of the the power line, use the method for checking both the statuses of the main and subsidiary magnetic contacts.
This function can be selected by the parameter setting:

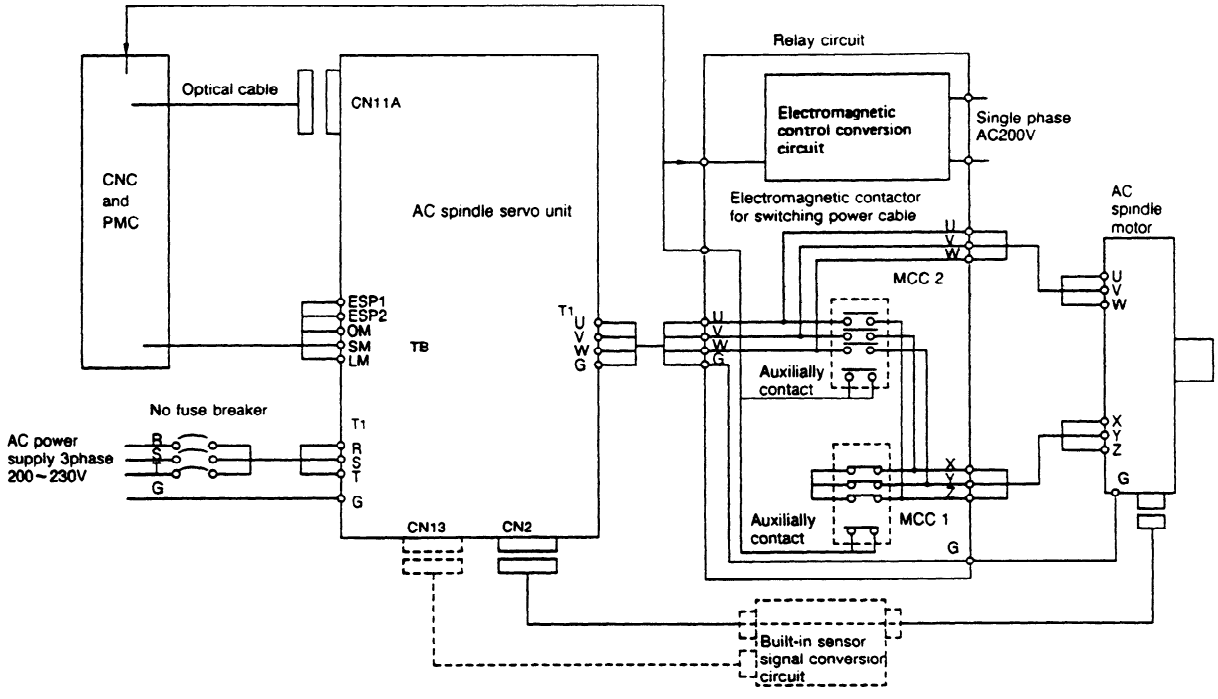
Series 0C: No. 6514 #3 = 1
Series 15: No. 3014 #3 = 1
Series 16: No. 4014 #3 = 1
PowerMate: No. 3014 #3 = 1

This function applied control software ROM series and edition number:

9A11 H version and later.
9A21 F version and later.
9A50 H version and later.

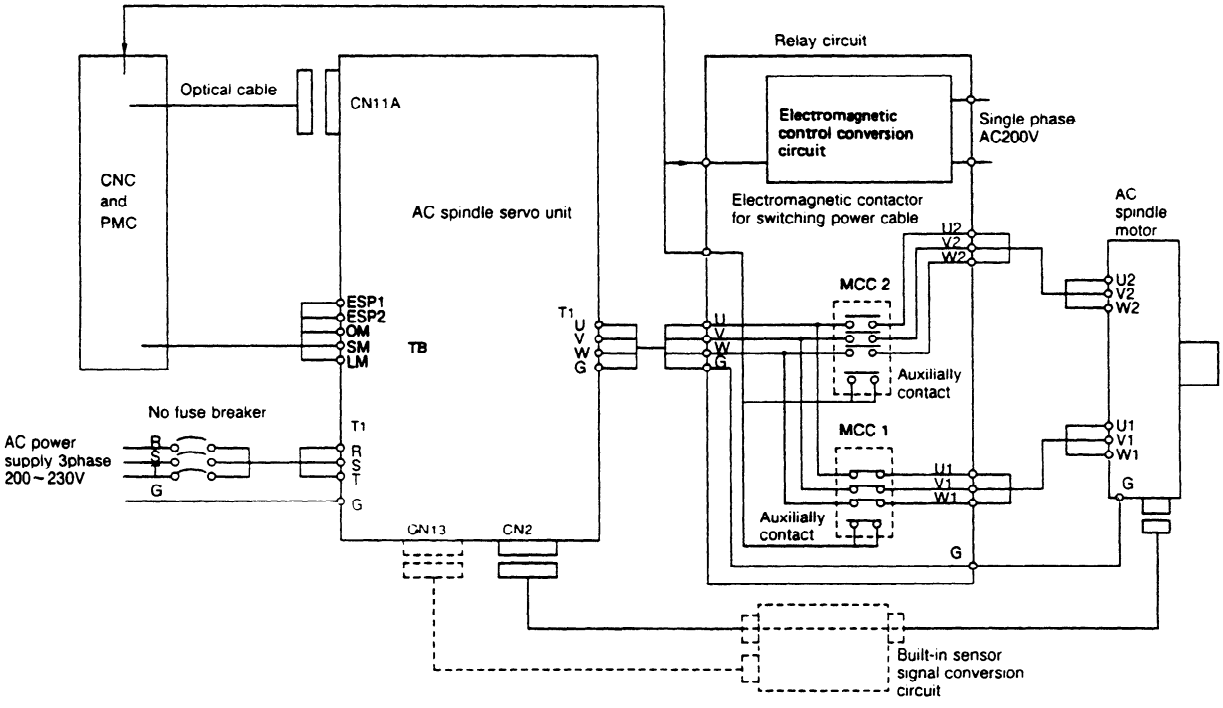
4. CONNECTIONS

4.1 Type A



Items such as units and cables other than the AC spindle servo unit and, AC spindlemotor, which are surrounded by the unbroken line, must be provided by the machine tool builder.

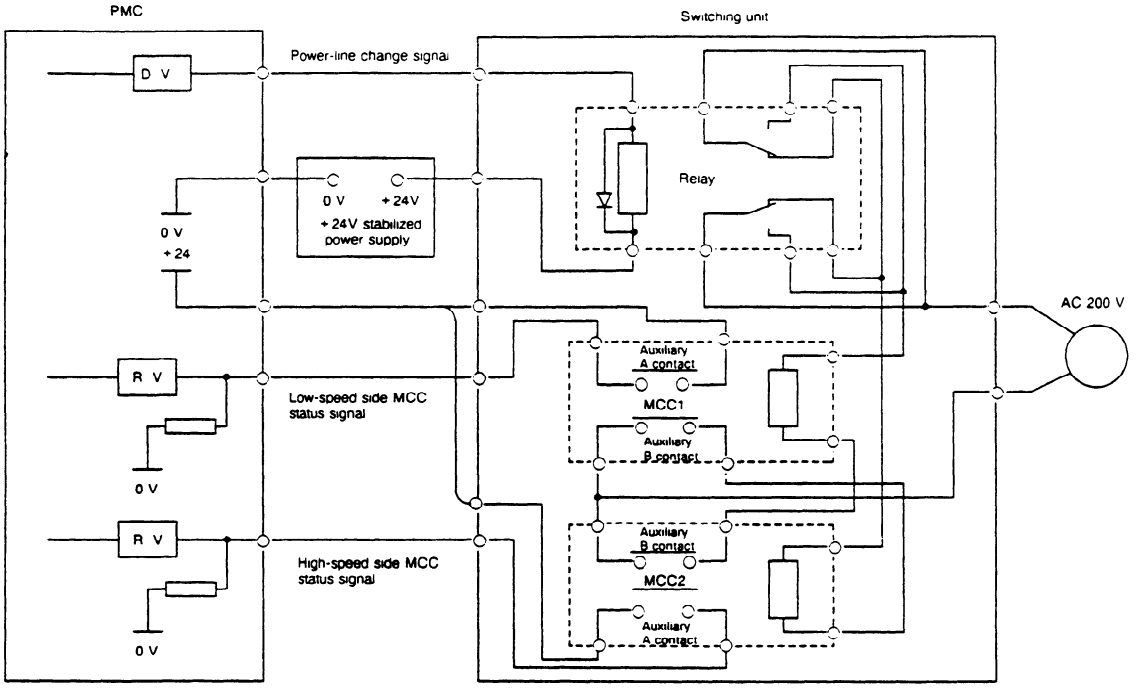
4.2 Type B



Items such as units and cables other than the AC spindle servo unit and, AC spindlemotor, which are surrounded by the unbroken line, must be provided by the machine tool builder.

4.3 Details of Connection between PMC and Switching Unit

It shows the case that the status of the electromagnetic contactors both on the high-speed side and on the low-speed side is inputted.



(Note 1) The above drawing is an example of connections for a switching unit that switches with 1 driver and 2 receivers. The electromagnetic contactor state signal confirmed only low-speed characteristic side (MMC1) in the conventional connector.

(Note 2) The main contact terminals and power line in contact are omitted.

(Note 3) Add a surge absorber to the electromagnetic contactor operation coil as necessary.

(Note 4) Use a power-line switching electromagnetic contactor with the proper capacity for each spindle motor.

5. INTERFACE SIGNALS

See Part V for details related to signals other than those described below.

5.1 Spindle Control Signals

5.1.1 Input signals (DI signals) PMC to CNC

	PM	0C	15	16	#7	#6	#5	#4	#3	#2	#1	#0
1ST:	G112	G229	G227	G070	MRDYA	ORCMA	SFRA	SRVA	CTH1A	CTH2A	TLMHA	TLMLA
2ND:	-	G233	G235	G074	MRDYB	ORCMB	SFRB	SRVB	CTH1B	CTH2B	TLMHB	TLMLB
1ST:	G113	G230	G226	G071	RCHA	RSLA						
2ND:	-	G234	G234	G075	RCHB	RSLB						
1ST:	G114	G231	G229	G072	RCHHGA			OVRA	DEFMDA	NRROA	ROTAA	INDXA
2ND:	-	G235	G237	G076	RCHHGB			OVRB	DEFMDB	NRROB	ROTAB	INDXB

5.1.2 Change request signal (RSLA, RSLB)

[Function]

It is used as an instruction signal which selects power characteristics.

0: The high-speed characteristic is selected.
1: The low-speed characteristic is selected.

[Usage]

This instruction is usually set according to the velocity command (S instruction). In this case, parameter No. 6519 #4 = 1 (FS0) is set to work the change operation after speed detecting signal (SDTA) is confirmed on the spindle side, because a low-speed characteristic is selected immediately after the velocity command changes from a high speed to a low speed above the change speed. (It is applied to 9A11/A, 9A21/F, 9A50/H version or later.)

In addition, there is a method that this instruction is selected by the speed detecting signal (SDTA) which is one of output signals of CNC (DO signal). But, please note that this method changes the speed detecting signal in the following cases.

(1) When the motor speed crosses the speed detection level in the constant surface speed control.
At using a low-speed characteristic, the change-operation can be prevented by clamping at the change speed with the instruction (G50, G92) that clamps the maximum spindle speed at the constant surface speed control.
(2) In the case that the motor speed crosses the speed detection level when the speed is changed by a spindle override.

Since the power of motor is turned off in change-operation when the speed range switching control works in the following control modes, please select either power characteristics beforehand, and please do not change the change request signal while working.

1) Rigid tapping mode
2) Cs contouring control mode
3) Spindle synchronous control mode
4) Spindle indexing mode
5) The spindle orientation is completed.

5.1.3 Power-line status check signal (RCHA, RCHB)

(1) Parameter No. 6514 #3 = 0 (FS0)

[Function]
The selection status signal of the electromagnetic contactor for the power characteristic changing of the spindle motor is inputted.

0: The high-speed characteristic is selected.
1: The low-speed characteristic is selected.

[Usage]
When the electromagnetic contactor changes from the low-speed side to the high-speed side, this signal is set from "1" to "0" after it is confirmed that the electromagnetic contactor on the low-speed side is off and that the electromagnetic contactor on the high-speed side is on.
When the electromagnetic contactor changes from the high-speed side to the low-speed side, this signal is set from "0" to"1" after it is confirmed that the electromagnetic contactor on the high-speed side is off and that the electromagnetic contactor on the low-speed side is on.

(2) Parameter NO. 6514 #3 = 1 (FS0)
(Rom series and edition number: Applied 9A11/H, 9A21/F, 9A50/H version or later)

[Function]
The opening and closing status signal of the electromagnetic contactor for a low-speed characteristic of the spindle motor is inputted.

0: The low-speed characteristic side electromagnetic contactor is open.
1: The low-speed characteristic side electromagnetic contactor is closed.

[Usage]
The status of the auxiliary contact ("A" contact) of electromagnetic contactor for a low-speed characteristic is usually inputted.
The status of the low-speed characteristic side electromagnetic contactor is inputted as this signal for parameter NO. 6514 #3 = 1 (FS0).

5.1.4 High-speed characteristic side electromagnetic contactor status signal (RCHHGA, RCHHGB)

This signal is effective for parameter NO. 6514 #3 = 1 (FS0).
(ROM series and edition number: Applied 9A11/H, 9A21/F, 9A50/H version or later)

[Function]

The opening and closing status signal of the electromagnetic contactor for a high-speed characteristic of the spindle motor is inputted.

0: The high-speed characteristic side electromagnetic contactor is open.
1: The high-speed characteristic side electromagnetic contactor is closed.

[Usage]

The status of the auxiliary contact ("A" contact) of the electromagnetic contactor for a high-speed characteristic is usually inputted.

5.1.5 Additional information about the Gear/Clutch signal (CTH1, 2)

(1) General

At the speed range switching control of the serial spindle, the Gear/Clutch signal (CTH1, 2) is used to select the velocity loop gain and the position loop gain for each of the low-speed range and the high-speed range.

(2) Explanation of the signal

Normaly, the Gear/Clutch signal (CTH1A, CTH2A) is used to select the spindle control parameters (Velocity loop gain, Position gain, Gear ratio) according to the gear or clutch.
At the speed range switching control of the serial spindle, the Gear/Clutch signal (CTH1A, CHT2A) is used to select the spindle control parameters according to the motor winding.

At the speed range switching control of the serial spindle, please change both of the Gear/Clutch signals (CTH1A and CTH2A) at the same time.

CTH1A	CTH2A	Gear/Clutch select condition	Winding select condition
0	0	High Gear (High)	High-speed range
0	1	Medium High Gear (High)	———
1	0	Medium Low Gear (Low)	———
1	1	Low (Low)	Low-speed range

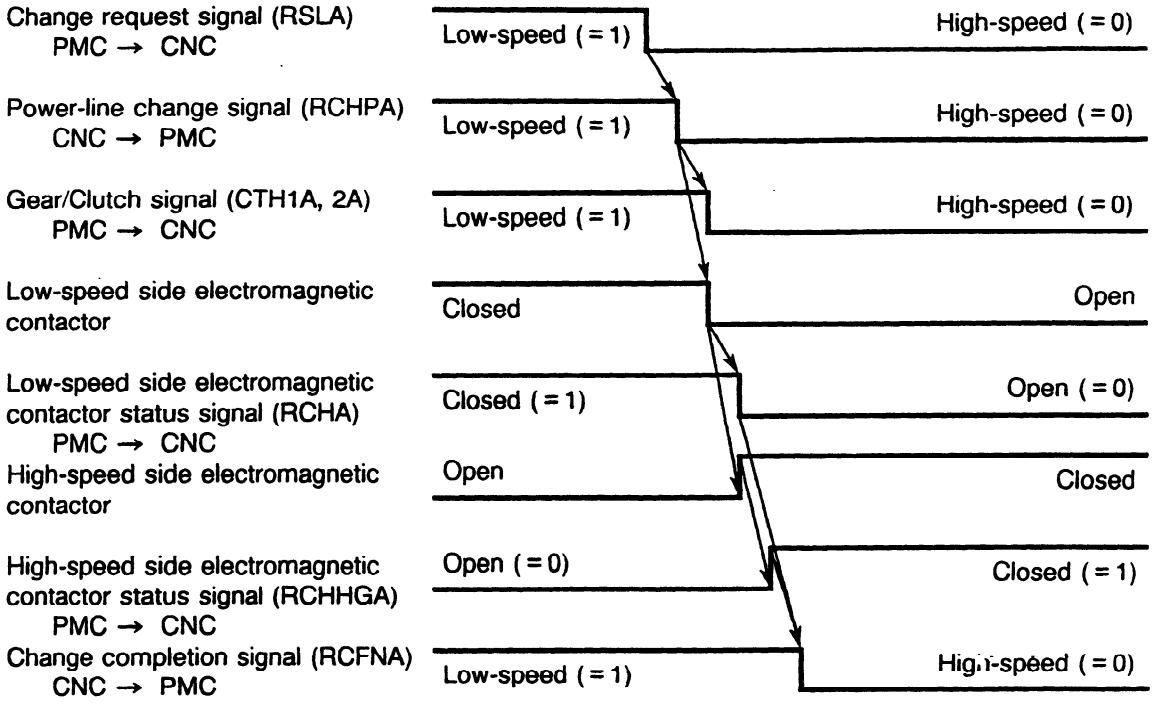
Please refer to page 005 to 006 about the relation between the Gear/Clutch signal (CTH1A, CTH2A) and the spindle control parameters.

(3) Sequence

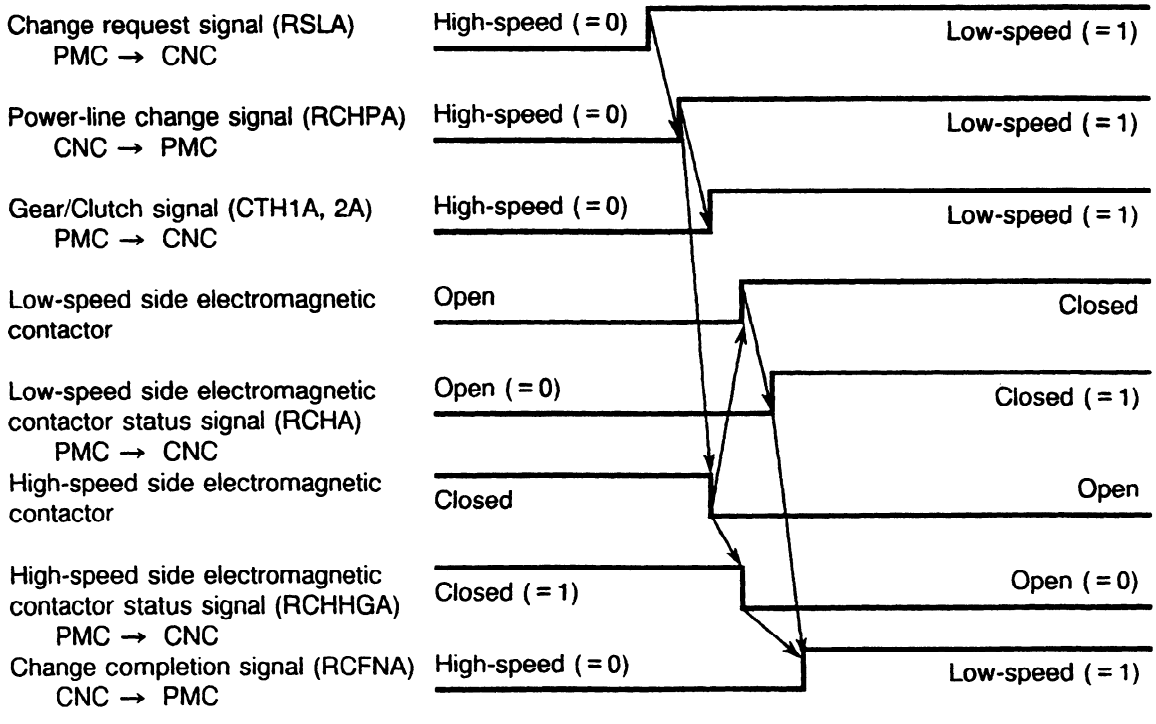
① When the status of both electromagnetic contactors for a low-speed characteristic (RCHA) and for a high-speed characteristic (RCHHGA) is confirmed and the speed range switching

control works (Parameter No.6514 #3 = 1 (FS0))
(Applied ROM series and edition number: 9A11/H, 9A21/F, 9A50/H version or later)

i) Change-operation of a low-speed characteristic → a high-speed characteristic

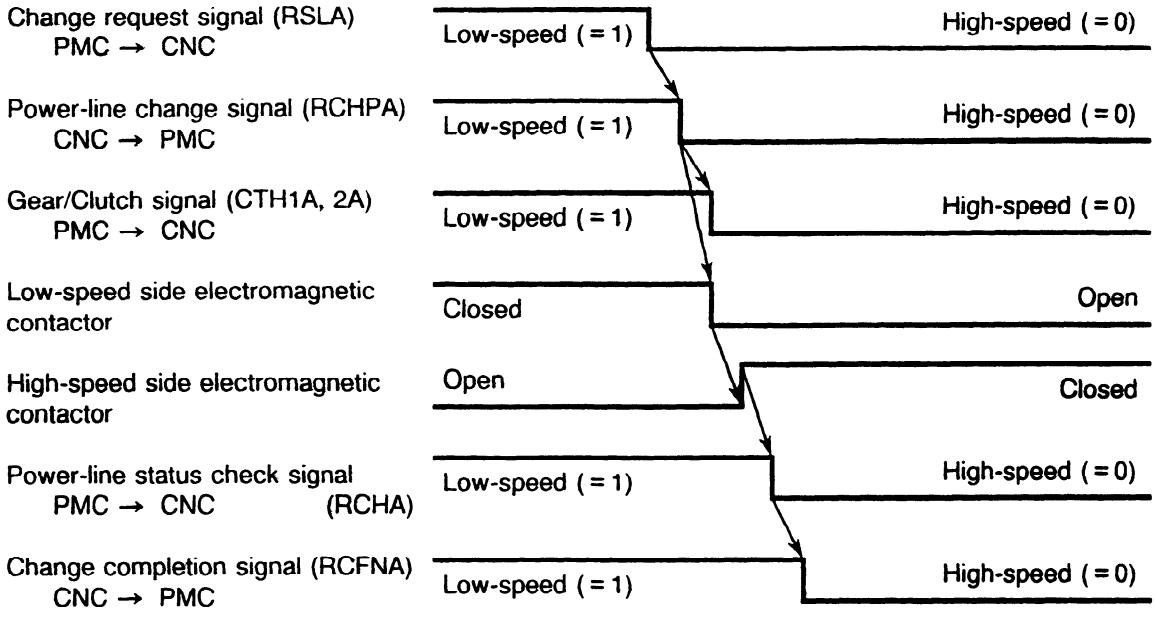


ii) Change-operation of a high-speed characteristic → a low-speed characteristic

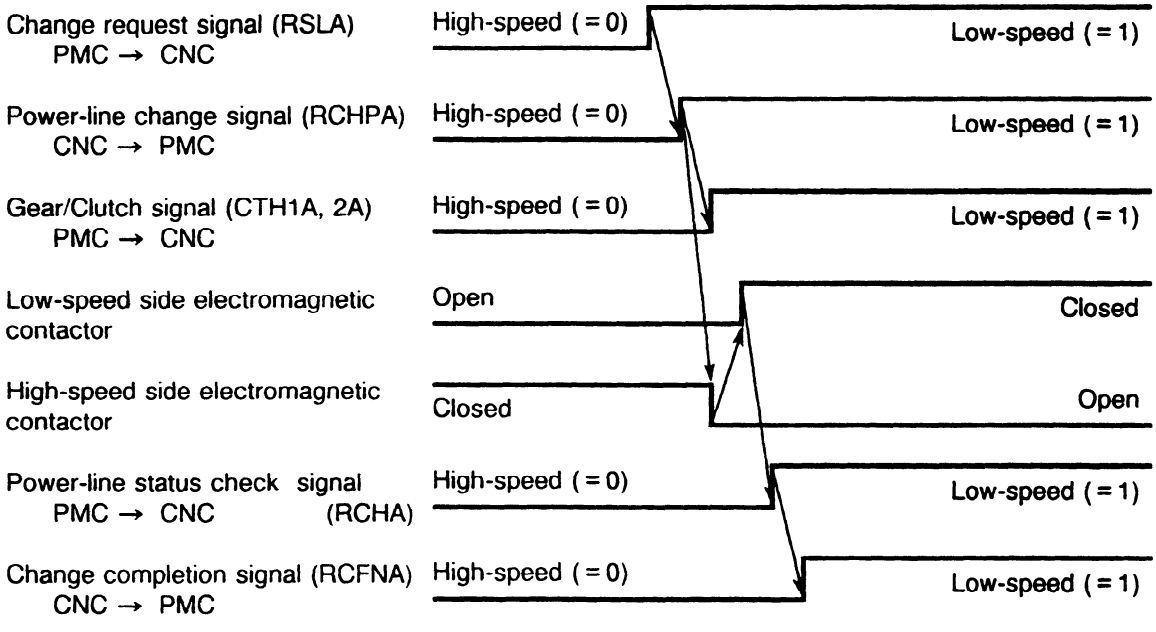


② When the speed range switching control works by confirming only the power-line status check signal (RCHA) (For parameter No.6514 #3 = 0 (FS0))

i) Change-operation of a low-speed characteristic → a high-speed characteristic



ii) Change-opeation of a high-speed characteristic → a low-speed characteristic



(4) About the relation between the Gear/Clutch signal (CTH1A, CTH2A) and the spindle control parameters.

High-speed characteristic is selected (CTH1A = 0, CTH2A = 0)

Parameter number				Data	
PM	0C	15	16		
3040	6540 6680	3040 3180	4040	Velocity loop proportional gain on normal operation.	(High)
3042	6542 6682	3042 3182	4042	Velocity loop proportional gain on orientation.	(High)
3044	6544 6684	3044 3184	4044	Velocity loop proportional gain on servo mode (Rigid tapping etc.)	(High)
3046	6546 6686	3046 3186	4046	Velocity loop proportional gain on Cs contouring mode.	(High)
3048	6548 6688	3048 3188	4048	Velocity loop integral gain on normal operation.	(High)
3050	6550 6690	3050 3190	4050	Velocity loop integral gain on orientation.	(High)
3052	6552 6692	3052 3192	4052	Velocity loop integral gain on servo mode (Rigid tapping etc.)	(High)
3054	6554 6694	3054 3194	4054	Velocity loop integral gain on Cs contouring mode.	(High)
3060	6560 6700	3060 3200	4060	Position gain on orientation.	(High)
3065	6565 6705	3065 3205	4065	Position gain on servo mode (Rigid tapping etc.)	(High)
3069	6569 6709	3069 3209	4069	Position gain on Cs contouring mode.	(High)

Low-speed characteristic is selected (CTH1A = 1, CTH2A = 1)

Parameter number PM	0C	15	16	Data	
3041	6541 6681	3041 3181	4041	Velocity loop proportional gain on normal operation.	(Low)
3043	6543 6683	3043 3183	4043	Velocity loop proportional gain on orientation.	(Low)
3045	6545 6685	3045 3185	4045	Velocity loop proportional gain on servo mode (Rigid tapping etc.)	(Low)
3047	6547 6687	3047 3187	4047	Velocity loop proportional gain on Cs contouring mode.	(Low)
3049	6549 6689	3049 3189	4049	Velocity loop integral gain on normal operation.	(Low)
3051	6551 6691	3051 3191	4051	Velocity loop integral gain on orientation.	(Low)
3053	6553 6693	3053 3193	4053	Velocity loop integral gain on servo mode (Rigid tapping etc.)	(Low)
3055	6555 6695	3055 3195	4055	Velocity loop integral gain on Cs contouring mode.	(Low)
3063	6563 6703	3063 3203	4063	Position gain on orientation.	(Low)
3068	6568 6708	3068 3208	4068	Position gain on servo mode (Rigid tapping etc.)	(Low)
3072	6572 6712	3072 3212	4072	Position gain on Cs contouring mode.	(Low)

(5) Caution

In the case of Series 15, please take care that Gear/Clutch signal (CTH1A, CTH2A) is also used to select the following parameters (Position gain of the feed axis, teeth number of arbitrary gear, time constant, backlash etc.) at the rigid tapping and the Cs contouring control.

5.2 Output Signal (DO signal) CNC → PMC

PMC address

	PM	0C	15	16	#7	#6	#5	#4	#3	#2	#1	#0
1ST:	F228	F281	F229	F045	ORARA	TLMA	LDT2A	LDT1A	SARA	SDTA	SSTA	ALMA
2ND:	-	F285	F245	F049	ORARB	TLMB	LDT2B	LDT1B	SARB	SDTB	SSTB	ALMB
1ST:	F229	F282	F228	F046					RCFNA	RCHPA	CFINA	CHPA
2ND:	-	F286	F244	F050					RCFNB	RCHPB	CFINB	CHPB

5.2.1 Power-line change signal (RCHPA, RCHPB)

[Function]

It is an instruction signal to select the electromagnetic contactor for the power characteristic changing of the spindle motor.

0: The electromagnetic contactor for a high-speed characteristic should be selected.
1: The electromagnetic contactor for a low-speed characteristic should be selected.

[Usage]

When change request signal (RSLA) changes, the power supply to the motor is automatically turned off.

Power supply OFF status continues until the change completion signal (RCFNA) changes.

At changing from the low-speed side to the high-speed side, this signal changes from "1" to "0" after the change request signal (RSLA) is received. As a result, the electromagnetic contactor for a low-speed characteristic is first turned off. After it is confirmed to have turned off the electromagnetic contactor for a low-speed characteristic, the electromagnetic contactor for a high-speed characteristic is turned on.

At changing from the high-speed side to the low-speed side, this signal changes from "0" to "1" after the change request signal (RSLA) is received. As a result, the electromagnetic contactor for a high-speed characteristic is first turned off. After it is confirmed to have turned off the electromagnetic contactor for a high-speed characteristic, the electromagnetic contactor for a low-speed characteristic is turned on.

5.2.2 Change completion signal (RCFNA, RCFNB)

[Function]

This signal shows by which power characteristic the spindle motor is controlled.

0: It is controlled by a high-speed characteristic.
1: It is controlled by a low-speed characteristic.

[Usage]

Change request signal (RSLA) changes. And after it is confirmed that this signal is corresponding to the change request signal (RSLA), it moves to the next movement.
Since the motor power is turned off until this signal is corresponding to the change request signal (RSLA) after the change of the change request signal (RSLA), please note not to apply the cutting load, etc. to the spindle in the change-operation.

5.2.3 Speed detecting signal (SDTA, SDTB)

[Function]

It becomes "1" while the motor speed is below the level (the change speed is normally set.) that is set by parameter.

0: It is above the change speed.
1: It is below the change speed.

[Usage]

It can be used for the change speed detection.
However, in the case that change-operation is done according to this signal, please note that this signal is changed by speed's changing when driven near the change speed and change-operation is occasionally done.
In this case, please do the change control with the velocity command (S instruction).

Hysteresis is given to this signal.
Quantity of hysteresis is set to 20 min^{-1} as an initial parameter. And it can be changed by the parameter (NO. 6924 (FS0)).
This width of hysteresis is set to the value with margin, which is two times value of measured speed change at change-operation.
It is calculated by the following equation as a standard of the set data.

$$\text{(Width of hysteresis)} = \frac{\text{(Change-operation time)}}{\text{(Acceleration time up to the max. speed)}} \times \text{(Max. speed)}_{min^{-1}} \times 0.2 : min^{-1}$$

↑
When motor load at change-operation is supposed to be 20 percent of maximum output torque

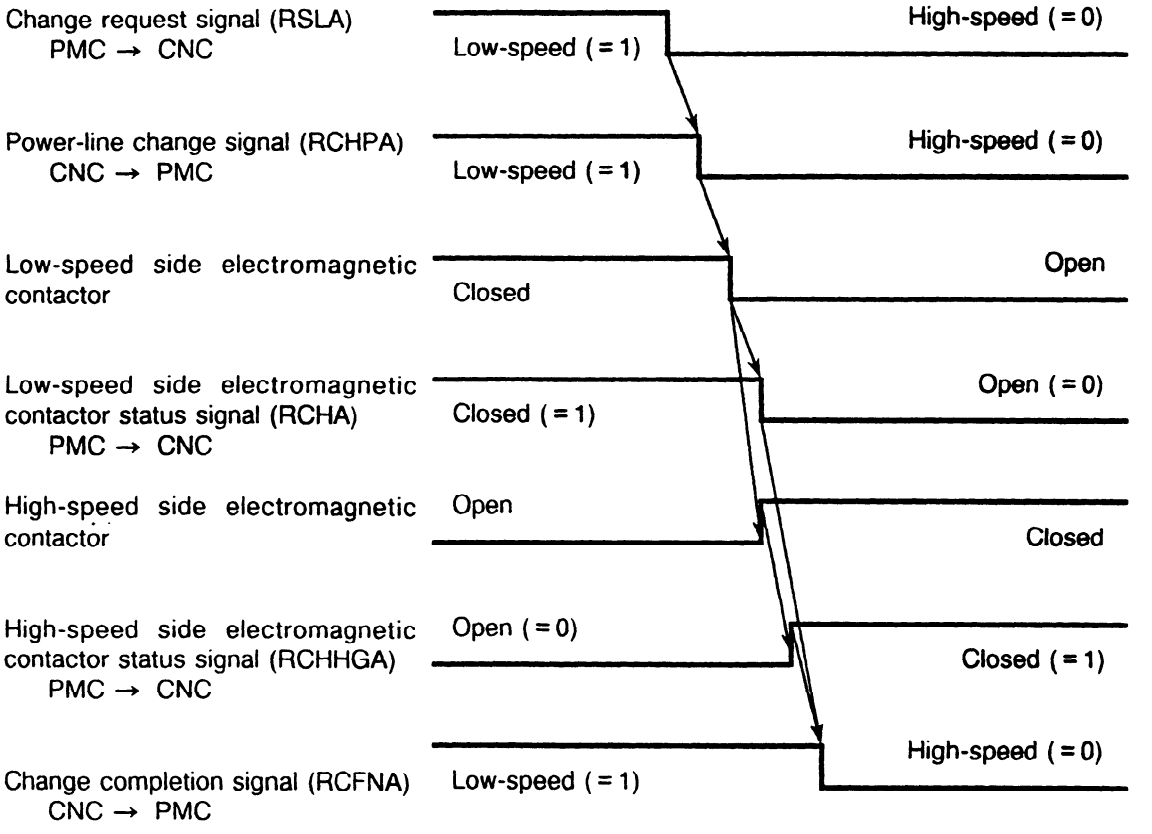
6. SEQUENCE

6.1 When the Status of both Electromagnetic Contactors for a Low-speed Characteristic (RCHA) and for a High-speed Characteristic (RCHHGA) is Confirmed and the Speed Range Switching Control Works

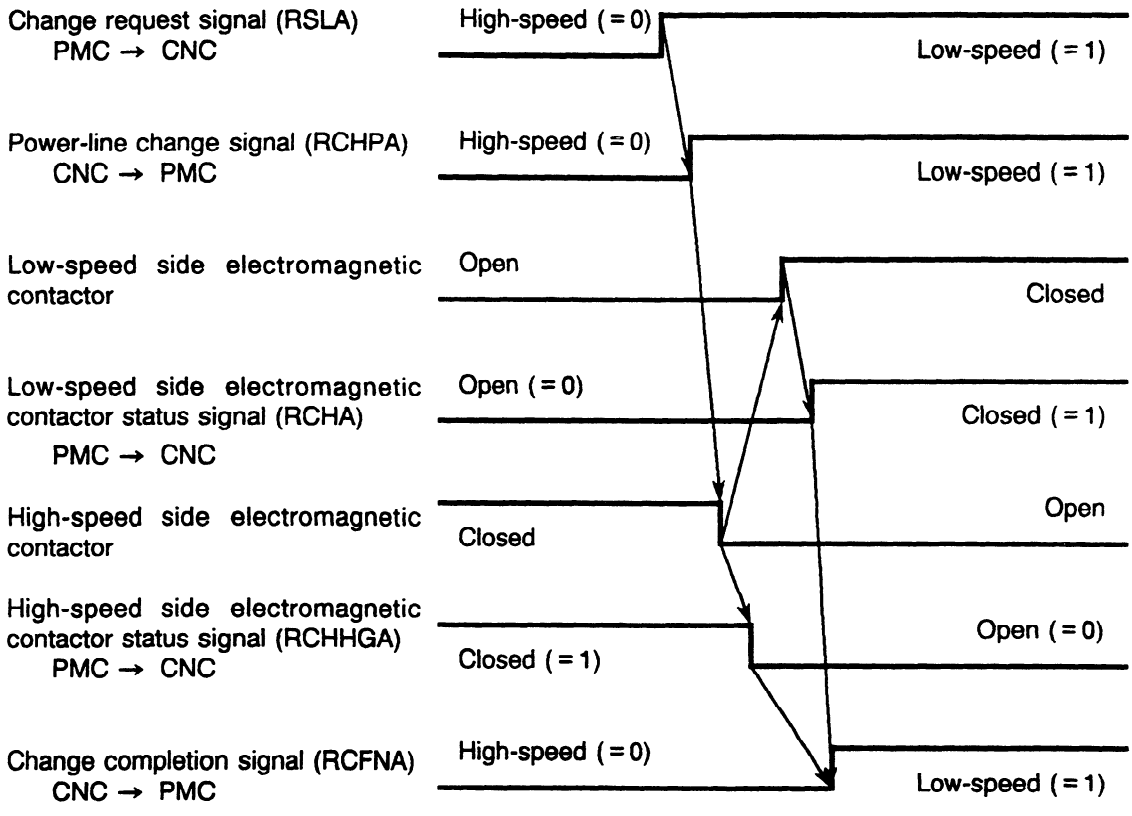
(Parameter NO. 6514 #3 = 1 (FS0))

(Applied ROM series and edition number: 9A11/H, 9A21/F, 9A50/H version or later)

6.1.1 Change-operation of a low-speed characteristic → a high-speed characteristic



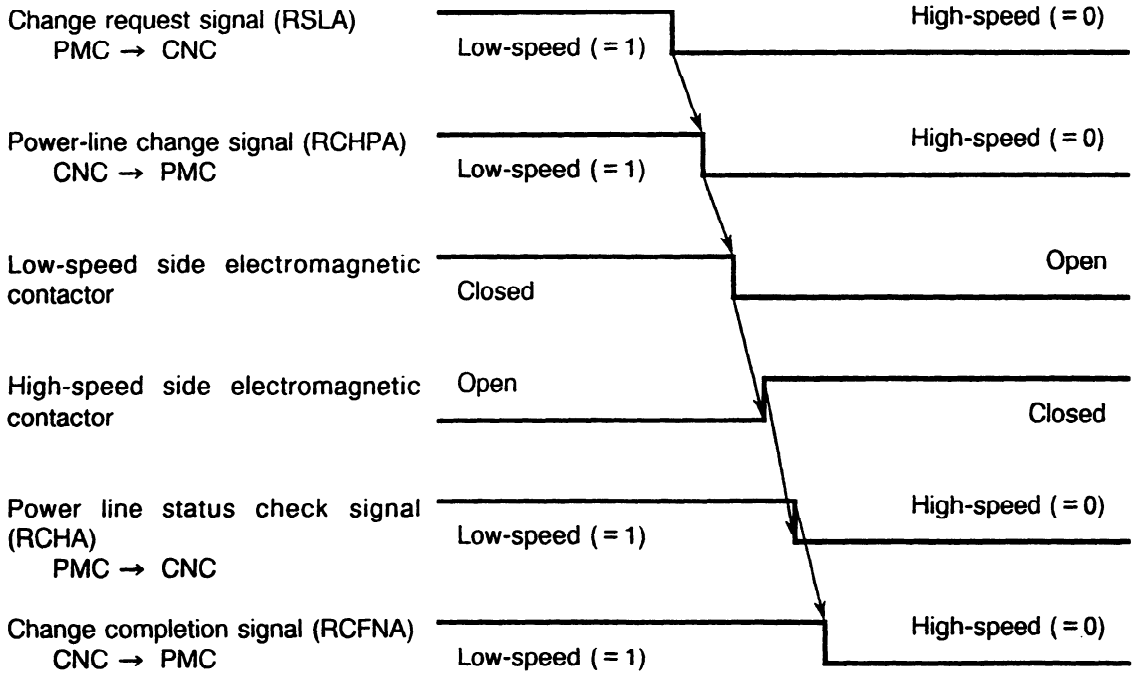
6.1.2 Change-operation of a high-speed characteristic → a low-speed characteristic



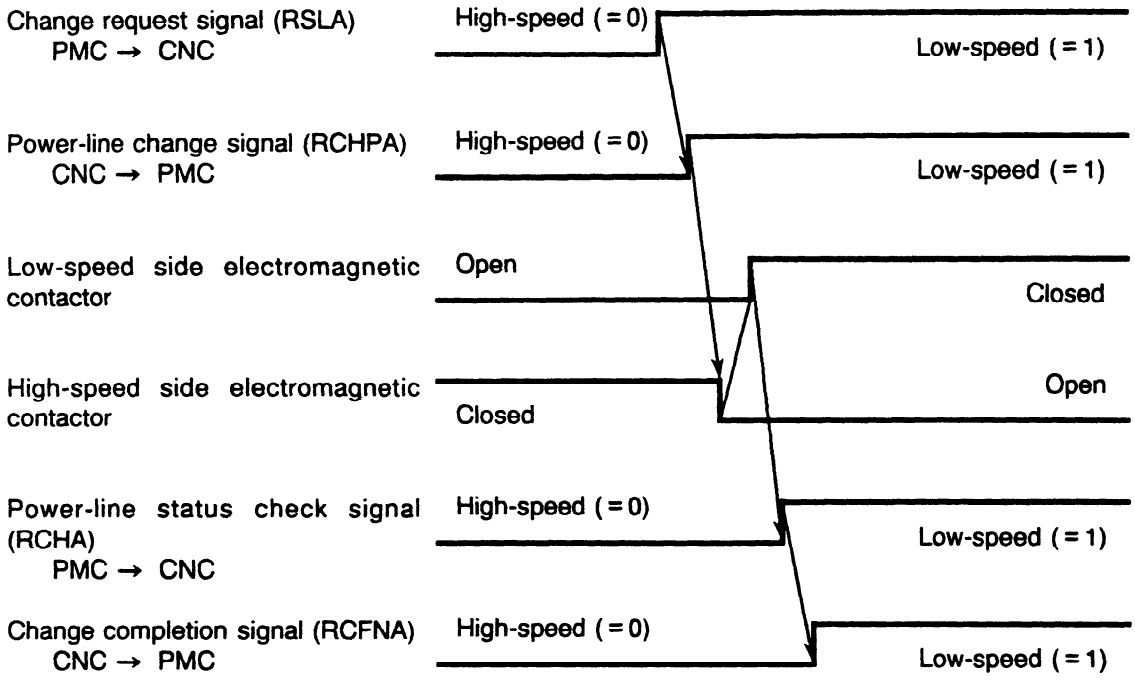
6.2 When the Speed Range Switching Control Works by Confirming Only the Power-line Status Check Signal (RCHA)

(For parameter NO. 6514 #3 = 0 (FS0)

6.2.1 Change-operation of a low-speed characteristic → a high-speed characteristic



6.2.2 Change operation of a high speed characteristic → a low-speed characteristic



(Note 1) When converting from high-speed output to low-speed output, conversion demand exceeding conversion speed can not be input. (This depends on the setting of parameter 6159#4.)

(Note 2) Because there are electromagnetic contactor operation delays etc. when checking electromagnetic contactor MCC1, MCC2 selection conditions in electromagnetic contactor MCC1 only, auxiliary contacts make sure that there is a minimum time lag of 50msec between operating the MCC1, MCC2 switch and changing the power cable condition verification signal (RCHA) with the power cable switching cable (RCHPA).

Be sure to take the delay time into account. Otherwise, switching between the low-speed and high-speed parameters in the amplifier will not operate properly, resulting in malfunctions such as motor vibration.

Make sure to input MCFN within 1 second of CHP being output otherwise Alarm AL-15 will be given if the power cable condition verification signal is not input within 1 second of the power cable switching signal being output.

7. ALARMS RELATED TO SPEED RANGE SWITCHING CONTROL

7.1 Speed Range Switching Control Sequence Alarm

(1) Alarm explanation

At parameter setting (NO. 6514 #3 = 1 (FS0)) that both contact status of the low-speed characteristic side and the high-speed characteristics side are confirmed, if the electromagnetic contactor status check signals for a low-speed characteristic (RCHA) and for a high-speed characteristic (RCHHGA) do not change within 1 second after the change request signal (RSLA) is changed, the alarm occurs.

At parameter setting (NO. 6514 #3 = 0 (FS0)) that only the power-line status check signal (RCHA) is confirmed, if the power-line status check signal (RCHA) does not change within 1 second after the change request signal (RSLA) is changed, the alarm occurs.

(2) Alarm display

It is displayed on 7 segment-LED of the spindle amplifier as AL-15 .

7.2 Power-line Status Abnormal Alarm

(Applied ROM series and edition number: 9A11/H, 9A21/F, 9A50/H version or later)

(1) Alarm explanation

It is always checked whether the change request signal (RCHA) and the status of power-line are corresponding. If they do not correspond for 10 seconds or more, the alarm occurs.

(2) Alarm display and the internal status display at the alarm

When this alarm occurs, the following alarm and the internal status at the alarm occurrence are alternately displayed on 7-segment-LED of the spindle amplifier.

Alarm display AL-55 and internal status

	*4	*3	*2	*1

at the alarm occurrence are alternately displayed.

Meaning of the displayed internal status is as follows.

*1: It displays which parameter was used at the alarm occurrence, a high-speed characteristic or a low-speed characteristic.

0: The motor was controlled by the parameter for a high-speed characteristic.
2: The motor was controlled by the parameter for a low-speed characteristic.

*2: It displays the low-speed side electromagnetic contactor status signal (RCHA) at the alarm occurrence for parameter NO. 6514 #3 = 1 (FS0).
(At parameter NO. 6514 #3 = 0 (FS0), the power-line status check signal is displayed.)

0: The low-speed side electromagnetic contactor status signal RCHA was "0" (Open).
(At parameter NO. 6514 #3 = 0 (FS0), the power-line status check signal RCHA was "0".)
2: The low-speed side electromagnetic contactor status signal RCHA was "1" (Closed).
(At parameter NO. 6514 #3 = 0 (FS0), the power-line status check signal RCHA was "1".)

*3: It displays the high-speed side electromagnetic contactor status signal (RCHHGA) at the alarm occurrence for parameter NO. 6514 #3 = 1 (FS0).
(At parameter NO. 6514 #3 = 0 (FS0), this display is invalid.)

0: The high-speed side electromagnetic contactor status signal RCHHGA was "0" (Open).
2: The high-speed side electromagnetic contactor status signal RCHHGA was "1" (Closed).

*4: It displays the change request signal (RSLA) at the alarm occurrence.

0: The high-speed side was selected.
2: The low-speed side was selected.

8. CAUTIONS IN USE

(1) Use an electromagnetic contactor for switching output whose capacity is suited for the AC spindle servo unit.
For the sake of reference, the table below lists the model ratings of electromagnetic contactors made by Fuji electric and Telemechanic.

Applicable AC spindle servo unit	30-minute rated current of the amplifier (A)	Electromagnetic contactor of Fuji Electric		Electromagnetic contactor of Telemechanic	
		Model ratings	Flowing current (A)	Model ratings	Flowing current (A)
1S	13.4	SC-4-0	22	LC1-D123A60	25
2S	27	SC-1N	50	LC1-D253A60	40
3S	30	SC-1N	50	LC1-D253A60	40
6S	35	SC-1N	50	LC1-D403	60
8S	48	SC-2N	60	LC1-D403	60
12S	63	SC-2SN	80	LC1-D633	80
15S	84	SC-3N	100	LC1-D803	125
18S	95	SC-4N	135	LC1-D803	125
22S	111	SC-5N	150	LC1-FF43	160
26S	133	SC-6N	150	LC1-FF43	160
30S	153	SC-7N	200	LC1-FG43	200
40S	183	SC-8N	260	LC1-FH43	315

(2) In order to suppress electrical noise generated at conversion in the electromagnetic contactor for speed range switching, use a surge absorber built into the resistor-condensor.

(3) When conducting rigid tapping, set the desired output characteristics in advance and do not perform switching.
Accordingly, when conducting rigid tapping, although the high-speed detection signal (SDTA) will be output from the AC spindle servo unit, be sure that this signal is ignored.

(4) Setting the machine ready signal (MRDYA)
For the purpose of safety, two signals have been included in the sequence to operable status. These are the emergency stop signal (*ESPA) and machine ready signal (MRDYA). Close the machine ready (MRDYA) contact to allow operation of the machine.

(5) Speed detection signal (SDTA) and selection signal
Two coils are installed within the AC spindle motor. Output characteristics can be changed by switching these two coils.

When conducting this speed range switching and the rigid tapping during rotation, the control may be limited by only the high-speed coil.
Ensure a sequence in the PMC that allows selection of 2 output characteristics and enables selection of a switching sequence during rotation.

(6) Use gear/clutch signal CTH1A and CTH2A to be able to set different speed loop gains for low-speed and high-speed.

XVI. SPINDLE SWITCHING CONTROL

1. GENERAL

Spindle switching control adds a spindle switching control printed circuit board to one AC spindle servo unit in a machine that has two spindle motors but does not move both simultaneously. Furthermore, it has an electromagnetic contactor to change power lines on the outside of the servo unit. The function works by switching between motors with the same characteristics or two motors that have different output characteristics.
It has the following uses.

(1) In turning centers etc. it uses a single spindle unit to switch the power line, velocity feedback signal line and the orientation signal line using the Main Spindle Motor for turning and the Sub Spindle Motor for rotation tools.
(2) It uses a single spindle unit to switch the power line, velocity feedback signal line and the orientation signal line using the vertical axis motor and horizontal axis motor of the machine tool with five- surface machining capability.

2. FUNCTIONS

The spindle switching control circuit has the following functions.

(1) Switches control from 1 motor to other motors.
(2) It switches velocity feedback signal lines.
(3) It switches orientation signal lines.
(It can switch both magnetic sensors and position encoders.)
(4) Fault detection functions
It gives an alarm (AL-15) when a power cable condition verification signal (MCFN) is not input within one second after the power cable switching signal (CHP) is output.
(5) In the spindle selector control, the input signals from PMC to CNC include the signal MCFNA as a power-line status check signal. and, the function that the status of the electromagnetic contactors both on the main spindle side and on the sub spindle side can be inputted is added, because the status of the power-line can be checked more certainly on the spindle side.
To check the status of the power line, use the method for checking both the statuses of the main and subsidiary magnetic contacts.
This function can be selected by the parameter setting:

Series 0C:	No. 6514 #2 = 1
Series 15:	No. 3014 #2 = 1
Series 16:	No. 4014 #2 = 1
PowerMate:	No. 3014 #2 = 1

This function applied control software ROM series and edition number:

9A11 H version
9A21 F version
9A50 H version

3. RESTRICTIONS

(1) The magnetic sensor spindle orientation function can be used on both MAIN and SUB spindles.
(2) When the position coder spindle orientation has only one stop position, it is used for both MAIN and SUB spindles.
(3) Rigid tap can be used on both MAIN and SUB spindles.
(4) An output switching function can be added to the spindle motor on the SUB side.
(5) The spindle index function (C axis control) is only available on the MAIN side. It is not available on the SUB side.
(6) Spindle synchronous control is only available on the MAIN side. It is not available on the SUB side.
(7) Cs contour control cannot be used.
(8) Gear change on the SUB side can be set to 2 stages. (On the Main side it can be set to 4 stages.)
(9) The spindle switching function cannot be used for the Power Mate.
(10) The following optional circuits cannot be used together with the spindle switching control circuit.

Optional circuit unusable with spindle switching control circuit	
Name	Specification drawing number
Built-in signal conversion circuit for built-in sensor	A06B-6064-J704 A06B-6064-J706
Position coder signal input circuit	A06B-6064-J703
Detection circuit for a high-resolution position coder	A06B-6064-J705
Detection circuit for a high-resolution magnetic pulse coder	A06B-6064-J720 A06B-6064-J721 A06B-6064-J722 A06B-6064-J724 A06B-6064-J725 A06B-6064-J726

(Note 1) Only the first stage can be set regarding the 2 gear setting stages on the velocity loop integrating gain.
(Note 2) The parameters given below are common with the MAIN side. (It is not possible to set the MAIN and SUB spindles separately.)

Series 0 No. 1 spindle	Series 0 No. 2 spindle	Series 15 No. 1 spindle	Series 15TT No. 2 spindle	
6527	6667	3027	3167	Load detecting level 2
6530	6670	3030	3170	Soft start/stop setting time
6587	6727	3087	3227	Overspeed level
6588	6728	3088	3228	Velocity error excess detecting level on motor restriction
6589	6729	3089	3229	Velocity error excess detecting level on motor rotation
6590	6730	3090	3230	Overload detecting level
6595	6735	3095	3235	Adjustment of speedmeter output voltage
6596	6736	3096	3237	Adjustment of load meter output voltage
6598	6738	3098	3238	Maximum speed of detecting position coder 1 rotation signal
6599	6739	3099	3239	Delay timer on position loop closed
6623	6763	3123	3263	Overload detecting time
6924	6964	3304	3524	Hysteresis width of speed detection signal (SDT)

4. CONFIGURATION AND ORDERING DRAWING NUMBERS

4.1 Configuration

In order to control the spindle motors with 1 servo unit, the following items are required apart from the AC spindle motor and servo unit.

(1) Spindle switching control circuit.
(2) Electromagnetic contactor for switching magnetic lines.
(3) Switching signal from the power sequence.

Configuration is shown in Fig. 4.1.

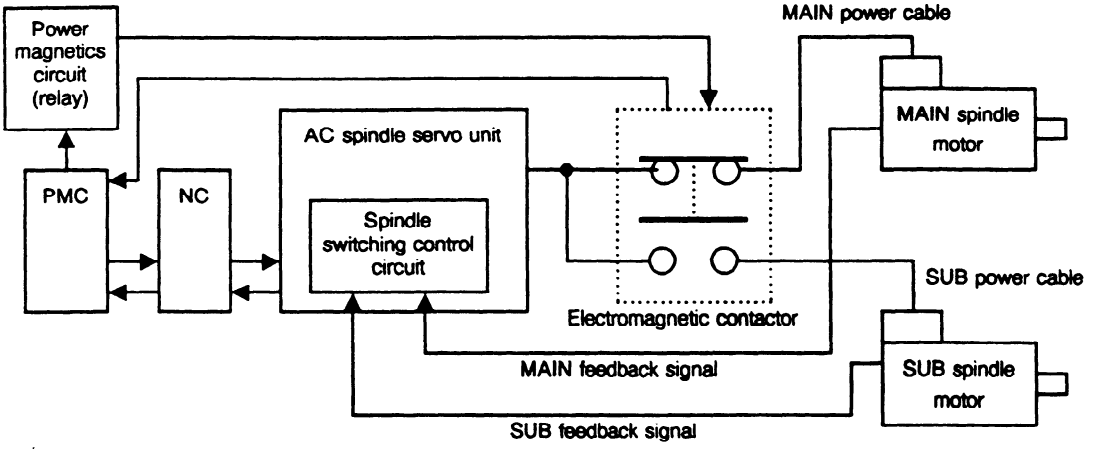


Fig. 4.1 System Configuration with Switching Signals

4.2 Motor Assembly, Unit

It is possible to assemble all moving Main and SUB spindle motors with the serial interface spindle servo unit (unit 1S-26S).
Select a spindle servo unit that is not only compatible with both motors, but one that also has a large capacity. Note however that it is necessary to change parameters according to the configuration. (See Section 7.2)

4.3 Order Drawing Number

The following units and options are necessary when using the spindle switching control function.
Spindle servo unit

Models 1S-26S

A06B-6064-H3XX#H551 (XX:01-26, ROM series 9A50)

Table 4.3 Spindle switching control circuit (optional)

Order specification No.	Function
A06B-6064-J701	No magnetic sensor or position coder signal switching function. (Only velocity feedback signal switching function)
A06B-6064-J702	Has both magnetic sensor and position coder signal switching functions.

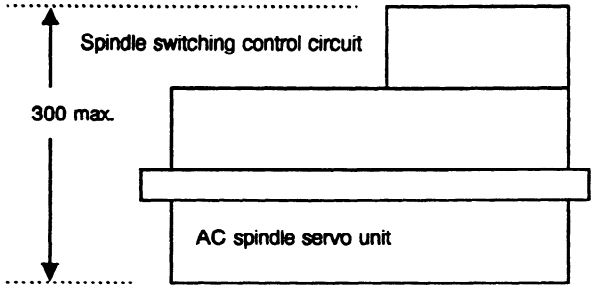
(Note) The following table shows the optional spindle switching circuits used with conven-tional types of models 6S to 22S (A06B-6063-HXXX#H511).

Order specification No.	Function
A06B-6063-J701	No magnetic sensor or position coder signal switching function. (Only velocity feedback signal switching function)
A06B-6063-J702	Has both magnetic sensor and position coder signal switching functions.

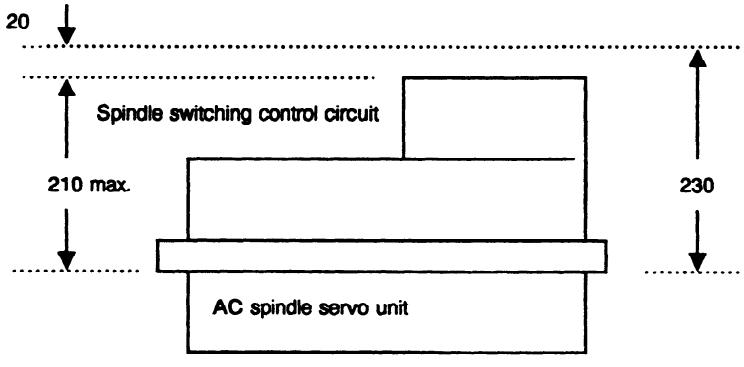
5. EXTERNAL DIMENSIONS OF SPINDLE SWITCHING CONTROL CIRCUIT

5.1 Models 6S-22S

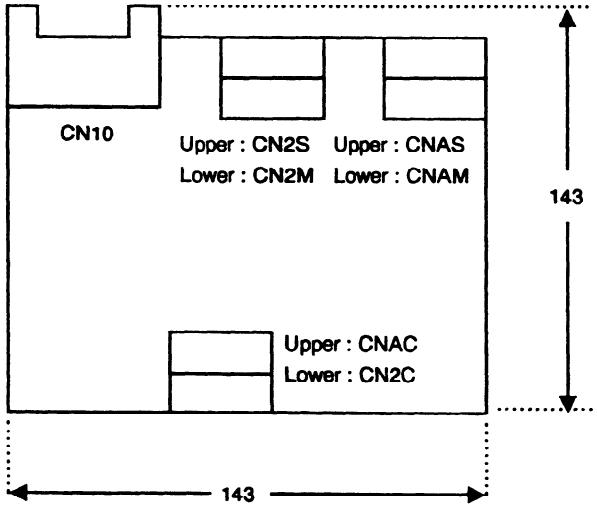
(1) The maximum height of AC spindle servo unit is 300 mm.



(2) The dimension of upper maintenance area is 230 mm.



5.2 External Figure of Spindle Switching Control Circuit

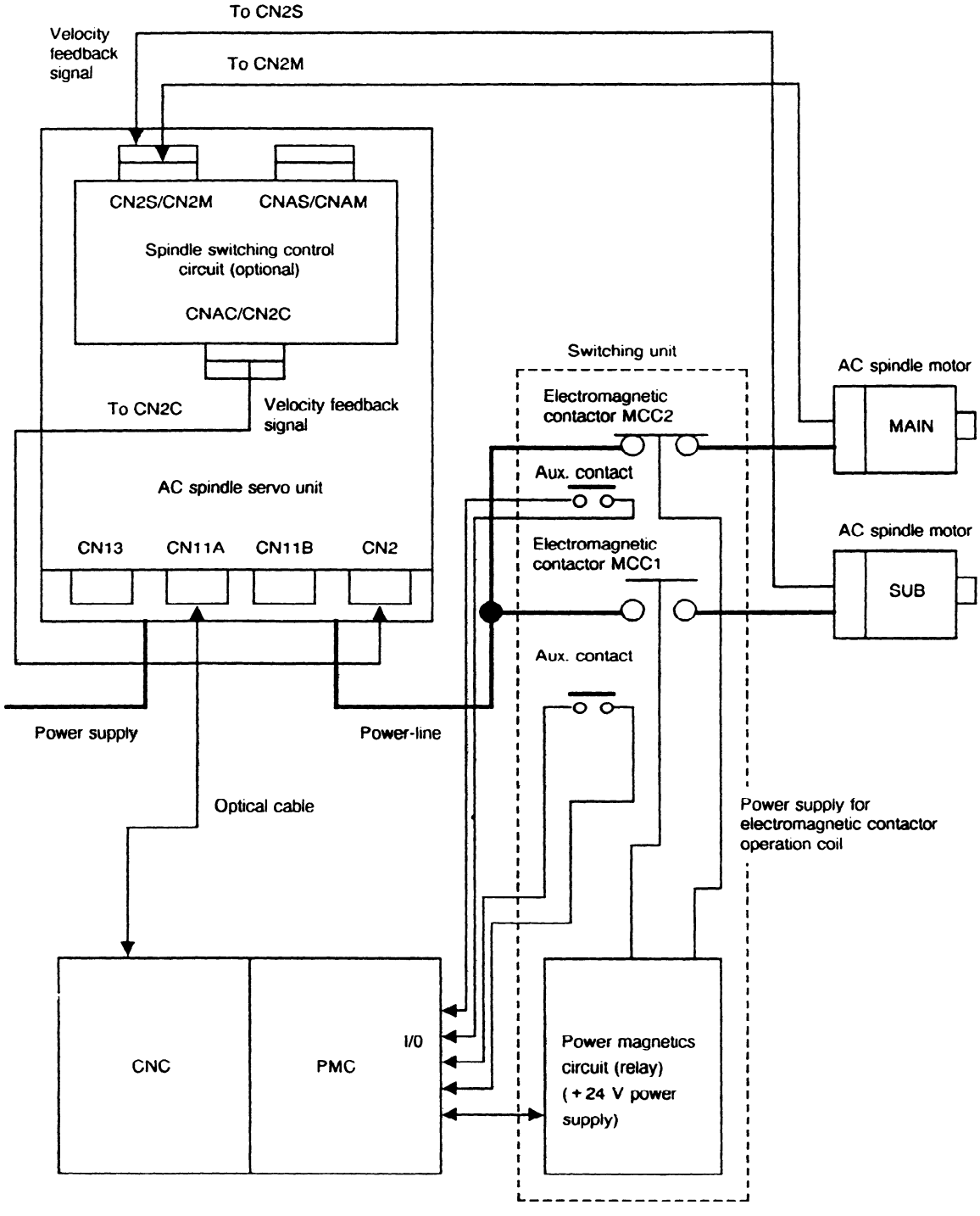


6. CONNECTION

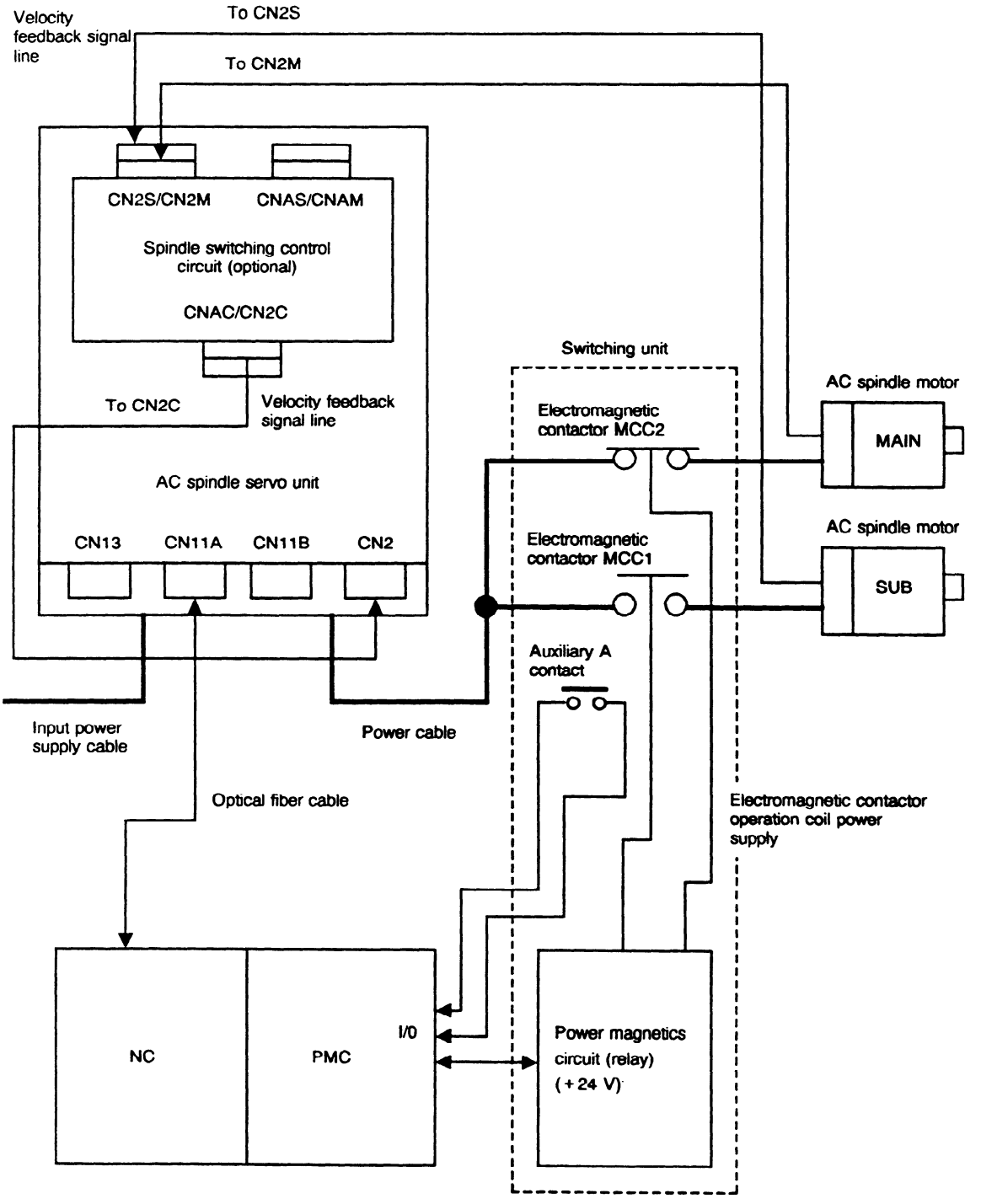
6.1 Connecting Diagram

(1) Only velocity feedback signal

It shows the case that the status of the electromagnetic contactors both on the spindle side and on the sub spindle side is inputted.



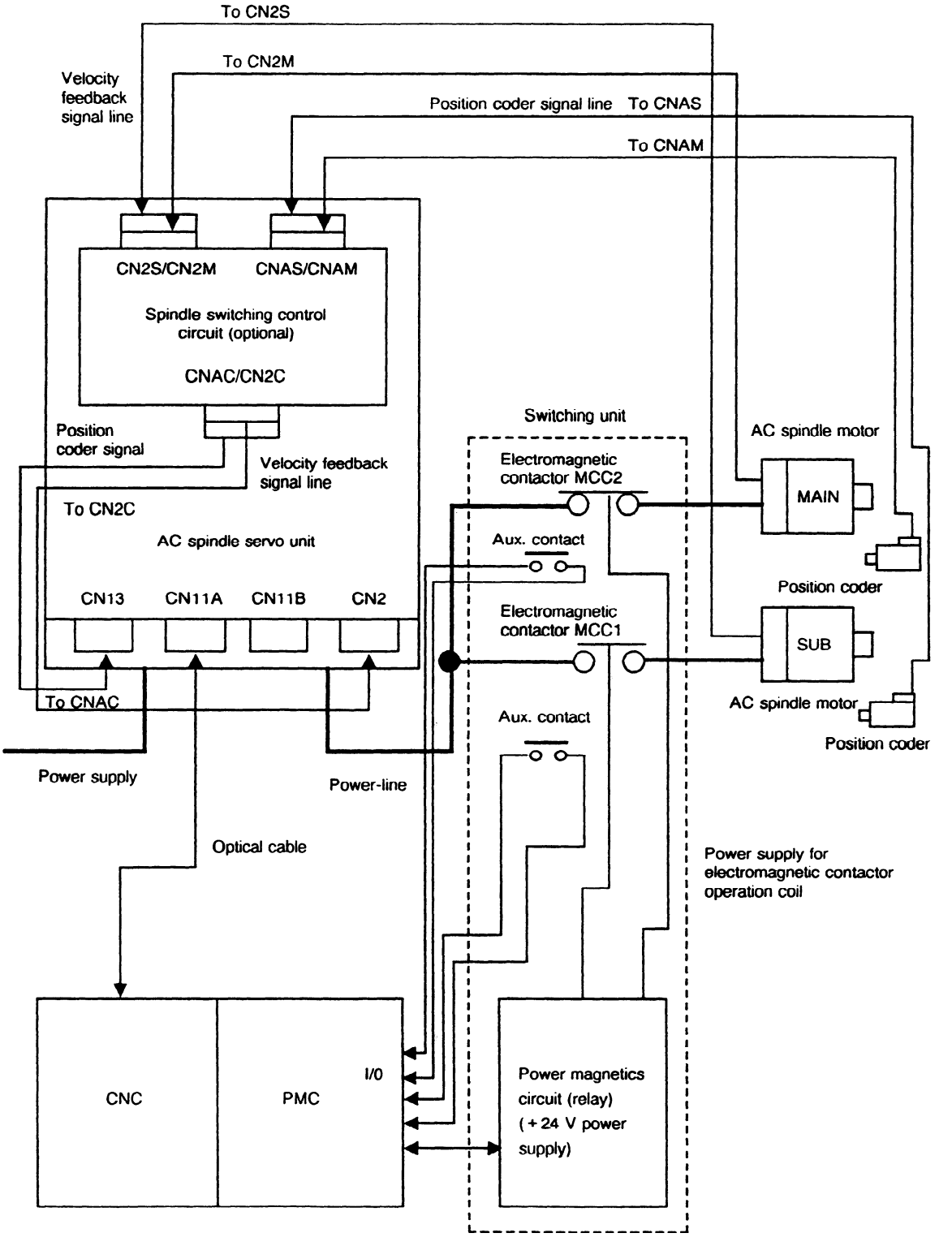
(2) It shows the case that the only status on the electromagnetic contactor on the sub spindle side is inputted. (Usual method)



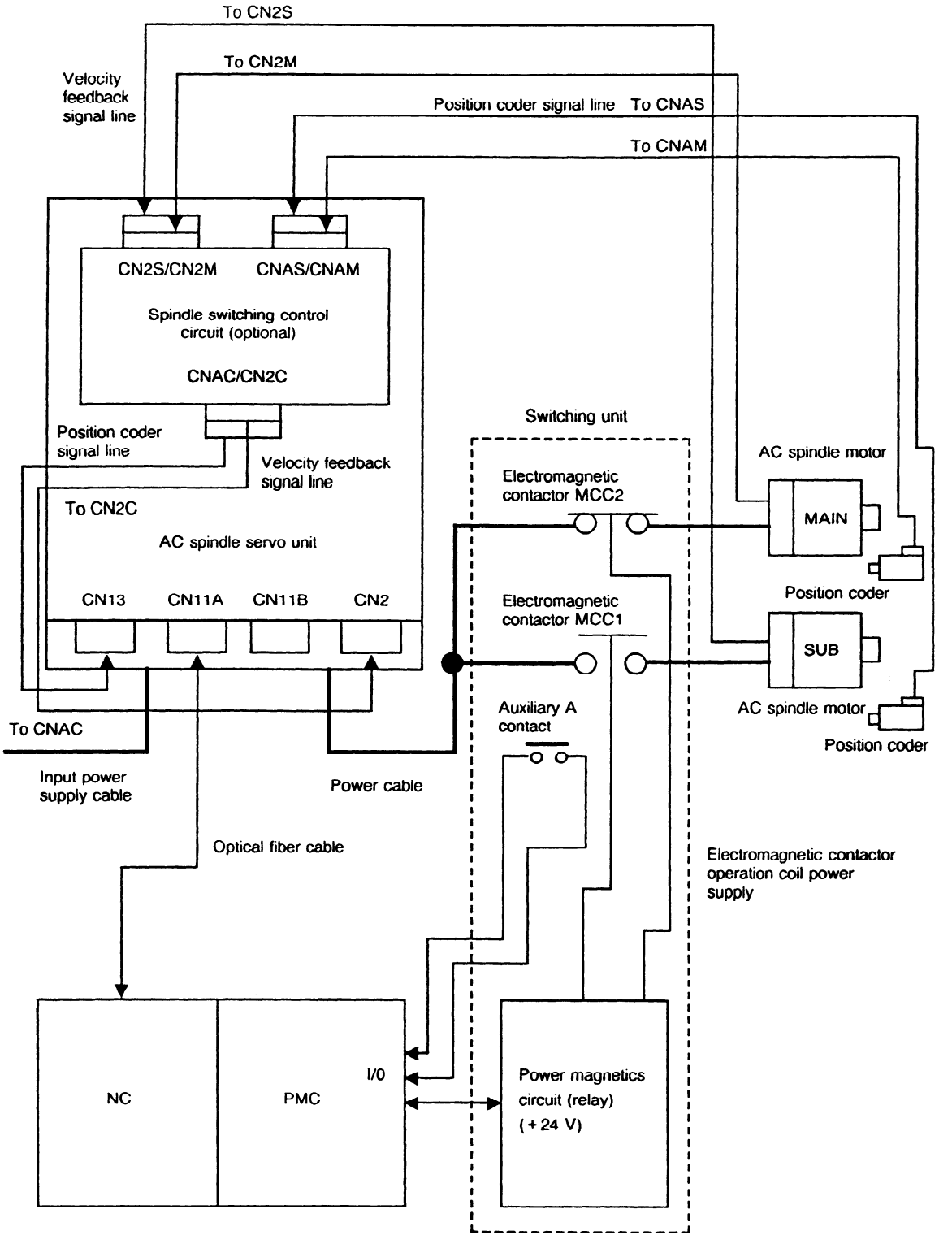
6.1.2 Velocity feedback signal and position coder signal

(1) Velocity feedback signal and position coder signal

It shows the case that the status of the electromagnetic contactors both on the spindle side and on the sub spindle side is inputted.



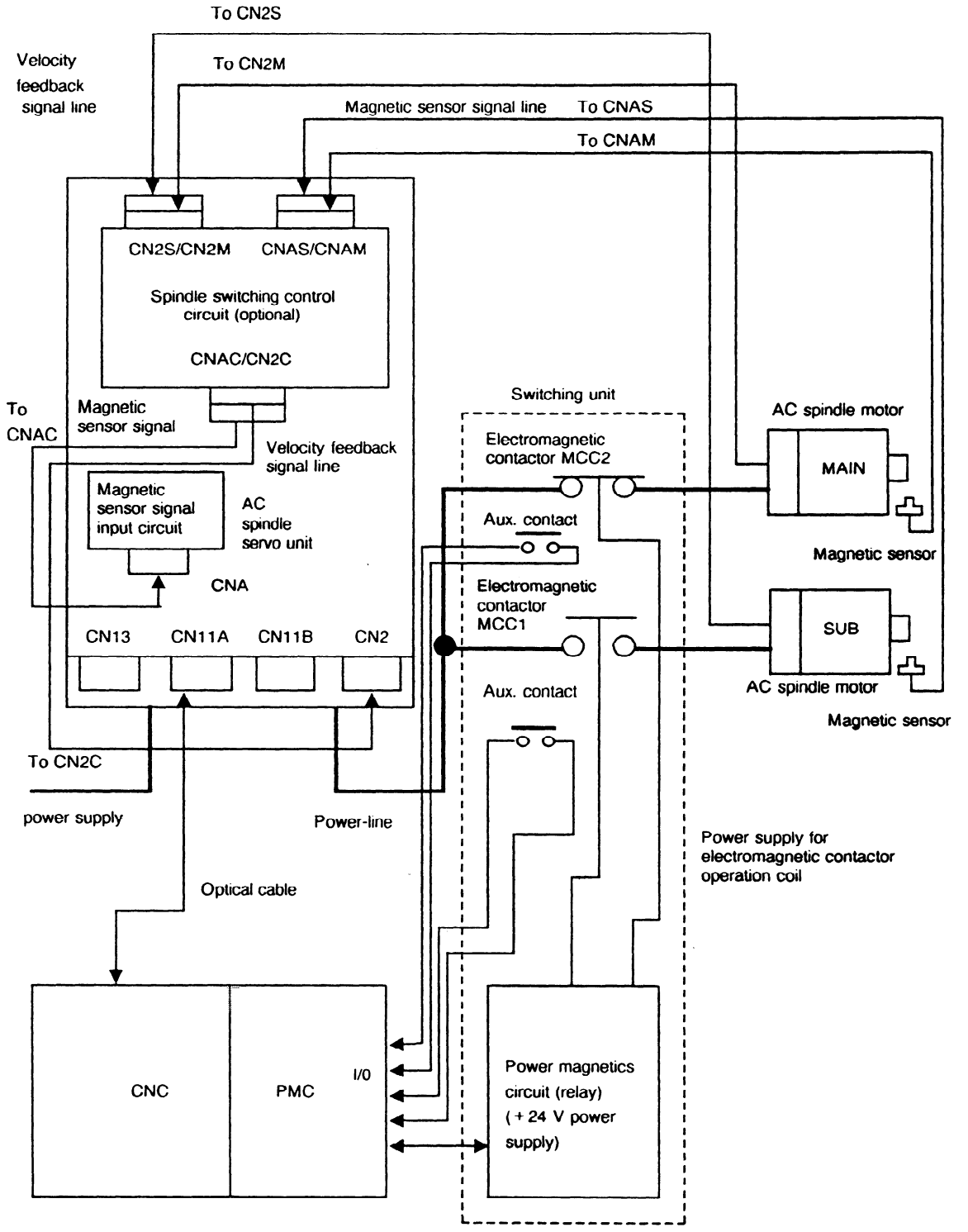
(2) It shows the case that the ony status on the electromagnetic contactor on the sub spindle side is inputted.



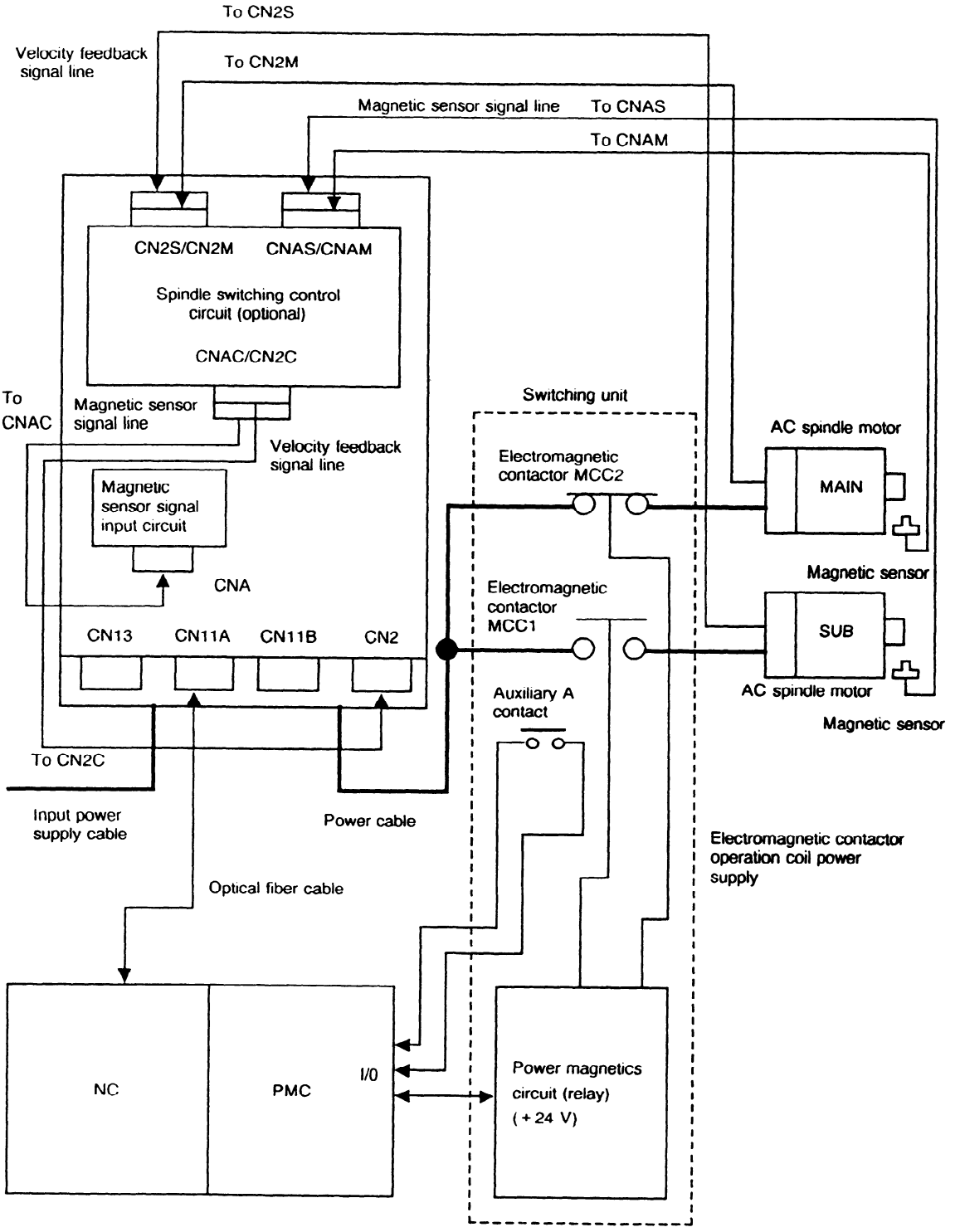
6.1.3 Switching for velocity feedback signal and magnetic sensor signal

(1) Velocity feedback signal and magnetic sensor signal

It shows the case that the status of the electromagnetic contactors both on the spindle side and on the sub spindle side is inputted.

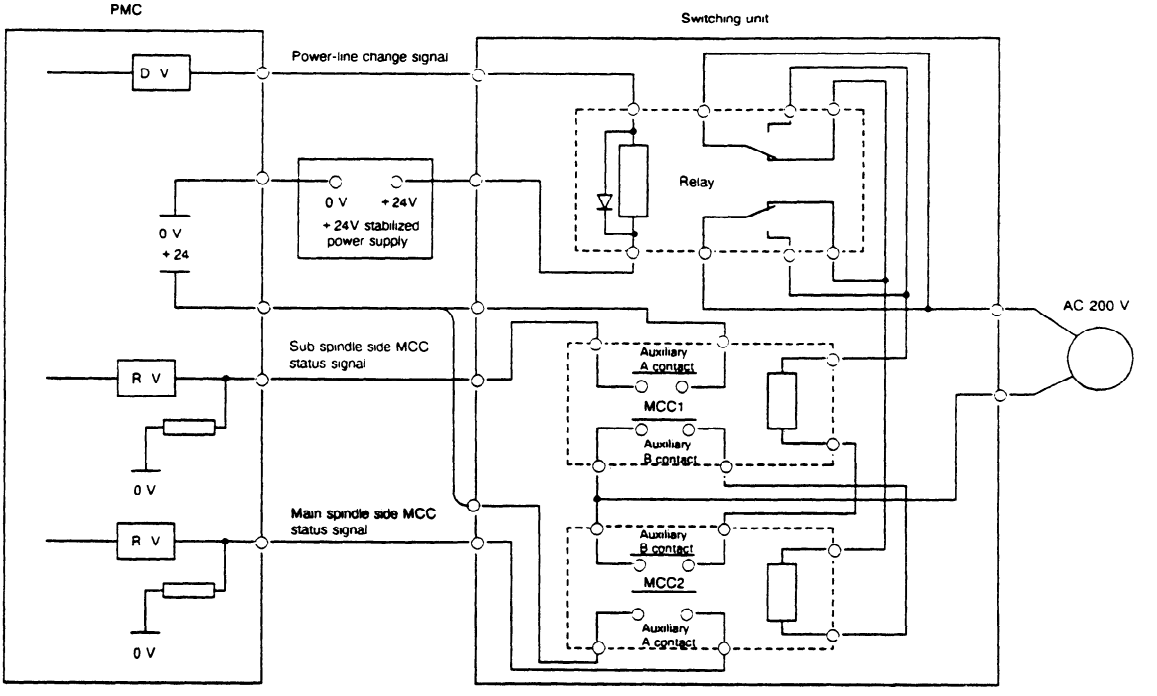


(2) It shows the case that the only status on the electromagnetic contactor on the sub spidle side is inputted.



6.2 Details of Connections for the PMC and Switching Unit

(1) It shows the case that the status of the electromagnetic contactors both on the high-speed side and on the low-speed side is inputted.



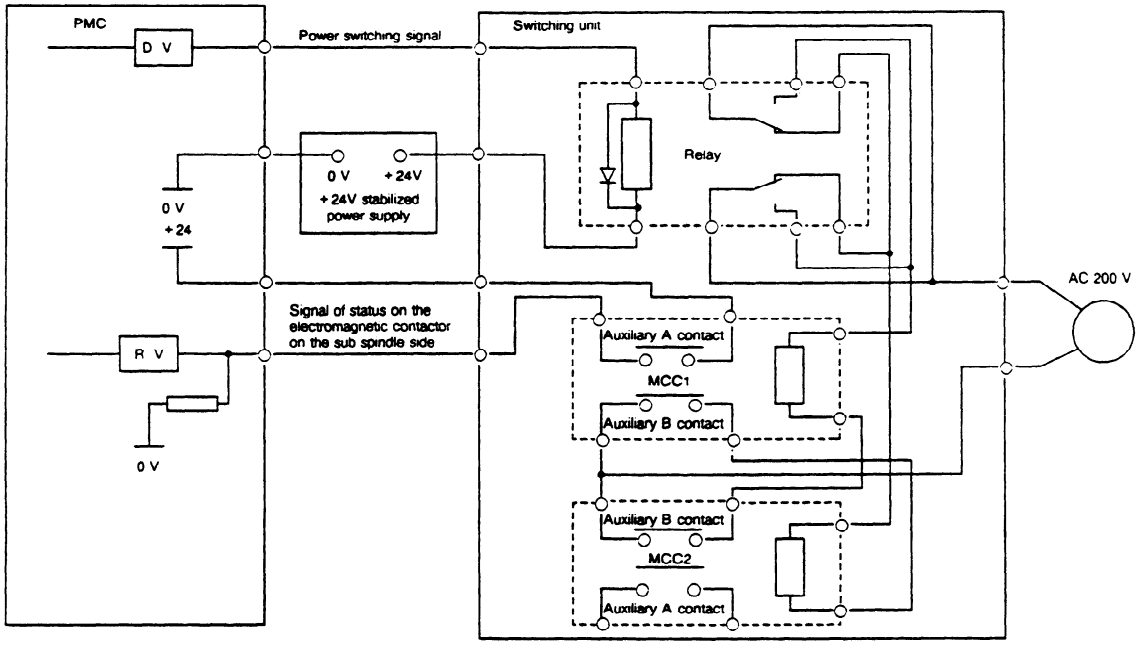
(Note 1) The above drawing is an example of connections for a switching unit that switches with 1 driver and 2 receivers. (It shows the case that AC 200V power supply is off.)

(Note 2) The main contact terminals and power line in contact are omitted.

(Note 3) Add a surge absorber to the electromagnetic contactor operation coil as necessary.

(Note 4) Use a power-line switching electromagnetic contactor with the proper capacity for each spindle motor.

(2) It shows the case that the only status on the electromagnetic contactor on the sub spindle side is inputed.



(Note 1) The above drawing is an example of connections for a switching unit that switches between driver 1 and receiver 1.

(Note 2) The main contact terminal and power in contact are omitted.

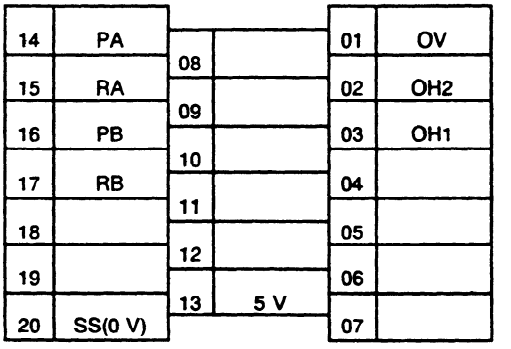
(Note 3) Add a surge absorber to the electromagnetic contactor operation coil as necessary.

(Note 4) Use a power switching cable electromagnetic contactor with the correct capacity for each spindle motor.

6.3 Connector

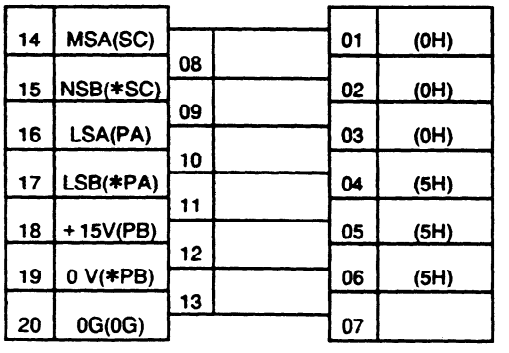
(1) Signal allocation diagram of CN2M, CN2S and CN2C are as follows.

CN2M: MAIN spindle velocity feedback signal input
CN2S: SUB spindle velocity feedback signal input
CN2C: Selected velocity feedback signal output



(2) Signal allocation diagram of CNAM, CNAS and CNAC are as follows.

CNAM: MAIN spindle magnetic sensor signal or position coder signal input
CNAS: SUB spindle magnetic sensor signal or position coder signal input
CNAC: Selected magnetic sensor signal or position coder signal output



Signal name: Magnetic sensor signal (Position coder signal)

7. PARAMETERS

7.1 Automatic Setting Method of 1 Spindle Parameter

(1) Set the following data in the NC bit data in order to carry out automatic setting.

Spindle motor	NC	Parameter address	Data
MAIN	Series 0	6519-BIT7	1
	Series 15	5607-BIT0	0
	Series 16	4019-BIT7	1
SUB	Series 0	6159-BIT7	1
	Series 15	5607-BIT0	0
	Series 16	4195-BIT7	1

(2) Set the motor parameter model code that carry out automatic setting in the following parameters.

Spindle motor	NC	Parameter address	
		No. 1 spindle	No. 2 spindle
MAIN	Series 0	6633	6773
	Series 15	3133	3273
	Series 16	4133	—
SUB	Series 0	6273	6454
	Series 15	3453	3654
	Series 16	4309	—

(3) The model parameters set by code will be automatically set when the NC power is switched OFF and then ON again.

7.2 Parameters Related to the Spindle Switching Control Function

Series 0	No. 1 spindle	:	6514
	No. 2 spindle	:	6654
Series 15	No. 1 spindle	:	3014
	No. 2 spindle	:	3154
Series 16	No. 1 spindle	:	4014

Data

				CHGSLT	AXSLCT	AXSUB	AXISSL
#7	#6	#5	#4	#3	#2	#1	#0

AXISSL : Specifies whether the spindle change function is enabled. (For 9A11, 9A21, and 9A50 series)

0: The spindle change function is disabled.

1: The spindle change function is enabled.

AXSUB : Specifies whether the function for changing spindles while the subspindle is rotating is enabled. (For 9A11, 9A21, and 9A50 series)

0: The function is disabled.

1: The function is enabled.

AXSLCT : Specifies whether the contacts of the magnetic contactors of both the main spindle and subspindle are checked. (For 9A11.H, 9A21.F, and 9A50.H series)

0: Checks the contacts with the power line status check signal. (MCFN)

1: Checks the contacts of both the main spindle and subspindle.

CHGSLT : Specifies whether the contacts of the magnetic contactors for both high and low outputs are checked. (For 9A11.H, 9A21.F, and 9A50.H series)

0: Checks the contacts with the power line status check signal. (RCH)

1: Checks the contacts for both high and low outputs.

7.3 Changing Parameters

It may be necessary to change parameters according to the assembly of the two motors. Make the changes after parameter automatic setting.

(1) Changing Current Dead Band Data
This parameter is set according to the unit and therefore the following changes are required according to the unit used.

Parameter changes
(Current Dead Band Data)

MAIN Spindle		SUB Spindle	
Series 0		Series 0	
No. 1 spindle :	6513	No. 1 spindle :	6153
No. 2 spindle :	6653	No. 2 spindle :	6333
Series 15		Series 15	
No. 1 spindle :	3013	No. 1 spindle :	3333
No. 2 spindle :	3153	No. 2 spindle :	3553
Series 16		Series 16	
No. 1 spindle :	4013	No. 1 spindle :	4189

		DS4	DS3	DS2	DS1		
#7	#6	#5	#4	#3	#2	#1	#0

DS4-DS1 Current Dead Band Data Settings
When using a 6S-12S unit : 0110
When using a 15S-26S unit: 1001

(Note) Beware that there is a possibility of damage being done to the power transistor of the unit if this parameter is not changed.

(2) Changing the current conversion constant (ICONV) and current estimate constant (IEST)
Make the following parameter changes on the motor side if the unit used is not compatible with the motor.

Parameter changes

MAIN Spindle		(ICONV)	(IEST)
Series 0	No. 1 spindle :	6610	6612
	No. 2 spindle :	6750	6752
Series 15	No. 1 spindle :	3110	3112
	No. 2 spindle :	3250	3252
Series 16		4110	4112

SUB Spindle		(ICONV)	(IEST)
Series 0	No. 1 spindle :	6228	6230
	No. 2 spindle :	6408	6410
Series 15	No. 1 spindle :	3408	3410
	No. 2 spindle :	3628	3630
Series 16		4264	4266

Calculating change values

ICONV1: Current conversion constant before change (default value)
ICONV2: New current conversion constant

IEST1: Current estimate constant before change (default value)
IEST2: New current estimate constant

G1: Current-detection gain of the original unit corresponding to the motor
G2: Current-detection gain of the unit used for switching spindles

$$ICONV2 = ICONV1 \times \frac{G1}{G2}, \quad IEST2 = IEST1 \times \frac{G2}{G1}$$

Using the formulas above, change the current conversion constant (ICONV) from the data of ICONV1 to the data of ICONV2, and change the current estimate constant (IEST) from the data of IEST1 to the data of IEST2.

The following table shows the current-detection gain (G1, G2).

Unit model	Current detection gain (G1, G2)
1S to 3S	46
Small 6S, 6S to 12S	30
Small 15S	24
15S to 22S	15
26S (Note)	12

(Note) When a model 3S motor or a smaller model is driven by amplifier model 26S as a subspindle motor, change the proportional gain of current loop to 80% of the standard setting.

(3) Examples of parameter change (When MAIN spindle data is 22S and SUB spindle data is 6S)

- Used unit 22S (A06B-6064-H322#H550)

	Value at automatic parameter setting		Value after parameter change	
	22S (MAIN)	6S (SUB)	22S (MAIN)	6S (SUB)
Current Dead band data	1001 (DS4~DS1)	0110	1001	1001
Current conversion constant	550	754	550	1508

(Note) Only the parameter on the 6S side is changed.

8. SPINDLE CONTROL SIGNALS

8.1 Input Signals (DI Signals) PMC to CNC

	0C	15	16	7	6	5	4	3	2	1	0
1ST:	G229	G227	G070	MRDYA	ORCMA	SFRA	SRVA	CTH1A	CTH2A	TLMHA	TLMLA
2ND:	G233	G235	G074	MRDYB	ORCMB	SFRB	SRVB	CTH1B	CTH2B	TLMHB	TLMLB
1ST:	G230	G226	G071	RCHA	RSLA	INTGA	SOCNA	MCFNA	SPSLA	*ESPA	ARSTA
2ND:	G234	G234	G075	RCHB	RSLB	INTGB	SOCNB	MCFNB	SPSLB	*ESPB	ARSTB
1ST:	G231	G229	G072	RCHHGA	MFNHGA		OVRA	DEFMDA	NRROA	ROTAA	INDXA
2ND:	G235	G237	G076	RCHHGB	MFNHGB		OVRB	DEFMDB	NRROB	ROTAB	INDXB

8.1.1 Change request signal (SPSLA, SPSLB)

[Function]

It is used as an instruction signal which selects the spindle motor.

0: The main spindle motor is selected.
1: The sub spindle motor is selected.

[Usage]

This signal is changed after stopping the spindle motor.

Speed zero signal (SSTA) is used for confirming that a spindle motor is stopping.

Since it is necessary that motor power is off for spindle changing, please set off the spindle rotation command (SFR/SRV) and the spindle orientatation command (ORCM) at changing spindle motors.

8.1.2 Power-line status check signal (MCFNA, MCFNB)

(1) Parameter NO.6514 #2 = 0 (FS0)

[Function]

The selection status signal of the electromagnetic contactor for changing the spindle motor power-lines is inputted.

0: The main spindle is selected.
1: The sub spindle is selected.

[Usage]

In the case of changing from the main spindle to the sub spindle, this signal is set from "1" to "0" after confirming that the electromagnetic contactor on the main spindle side is off and that the electromagnetic contactor on the sub spindle side is on.
In the case of changing from the sub spindle to the main spindle, this signal is set from "0" to "1" after confirming that the electromagnetic contactor on the sub spindle side is off and that the electromagnetic contactor on the main spindle side is on.

(2) Parameter NO.6514 #2 = 0 (FS0)

(ROM series and edition number: Applied 9A11/H, 9A21/F, 9A50/H version or later)

[Function]

The opening and closing status signal of the electomagnetic contactor for power-line on the sub spindle side is inputted.

0: The electromagnetic contactor on the sub spindle side is open.
1: The electromagnetic contactor on the sub spindle side is closed.

[Usage]

The status of the auxiliary contact ("A" contact) of the electromagnetic contactor on the sub spindle side is inputted.

8.1.3 Main spindle side electromagnetic contactor status signal (MFNHGA, MFNHGB)

(ROM series and edition number: Applied 9A11/H, 9A21/F, 9A50/H version or later)

This signal is effective for parameter NO.6514 #2 = 1 (FS0)

[Function]

The opening and closing status signal of the electromagnetic contactor for power-line on the main spindle side is inputted.

0: The electromagnetic contactor on the main spindle side is open.
1: The electromagnetic contactor on the main spindle side is closed.

[Usage]

The status of the auxiliary contact ("A" contact) of the electromagnetic contactor on the main spindle side is inputted.

8.2 Output Signal (DO signal) CNC → PMC

	PMC address			#7	#6	#5	#4	#3	#2	#1	#0
	0C	15	16								
1ST:	F281	F229	F045	ORARA	TLMA	LDT2A	LDT1A	SARA	SDTA	SSTA	ALMA
2ND:	F285	F245	F049	ORARB	TLMB	LDT2B	LDT1B	SARB	SDTB	SSTB	ALMB
1ST:	F282	F228	F046					RCFNA	RCHPA	CFINA	CHPA
2ND:	F286	F244	F050					RCFNB	RCHPB	CFINB	CHPB

8.2.1 Power-line change signal (CHPA, CHPB)

[Function]

It is an instruction signal to select the electromagnetic contactor for changing the spindle motor power-line.

0: The electromagnetic contactor for the main spindle should be selected.
1: The electromagnetic contactor for the sub spindle should be selected.

[Usage]

This signal is outputted after receiving the change request signal (SPSLA).
This signal selects the electromagnetic contactor for changing the spindle motor power-line.
At changing from the main spindle to the sub spindle, this signal changes from "0" to "1" after the change requewt signal (PSLA) is received.
As a result, the electromagnetic contactor for the main spindle is first turned off. After it is confirmed to have turned off the electromagnetic contactor for the sub spindle is turned on.
At changing from the sub spindle to the main spindle, this signal changes from "1" to "0" after the change request signal (SPSLA) is received.
As a result, the electromagnetic contactor for the sub spindle is first turned off. After it is confirmed to have turned off the electromagnetic contactor for the sub spindle, the electromagnetic contactor for the main spindle is turned on.

Please set off the spindle rotation command (SFR/SRV) and the spindle orientation command (ORCM) at changing the spindle, because this signal changes after confirming to have turned off the motor power.

8.2.2 Change completion signal (CFINA, CFINB)

[Function]

This signal shows by which spindle characteristic the spindle motor is controlled.

0: It is controlled by a main spindle characteristic.
1: It is controlled by a sub spindle characteristic.

[Usage]

The change request signal (SPSLA) changes, and after it is confirmed that this signal is corresponding to the change request signal (SPSLA), it moves to the next movement.
Since it is necessary that the motor power is off until this signal is corresponding to the change request signal (SPSLA) after the change of the change request signal (SPSLA), please set off the spindle rotation command (SFR/SRV) and the spindle orientation command (ORCM) at the change operation.

8.2.3 Speed zero signal (SSTA, SSTB)

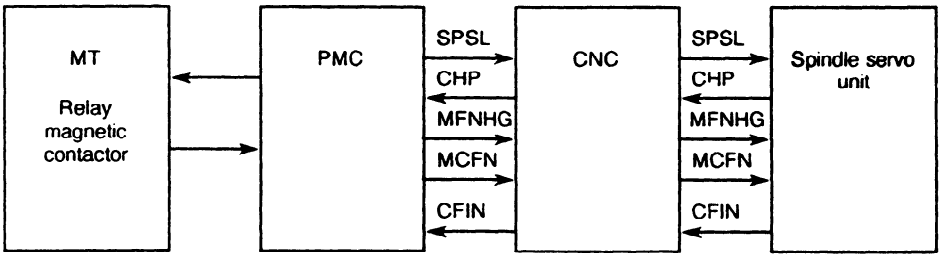
[Function]

It becomes "1" while the motor speed is below the speed zero detection level which is set by parameter.

0: It is above the speed zero detection level.
1: It is below the speed zero detection level.

[Usage]

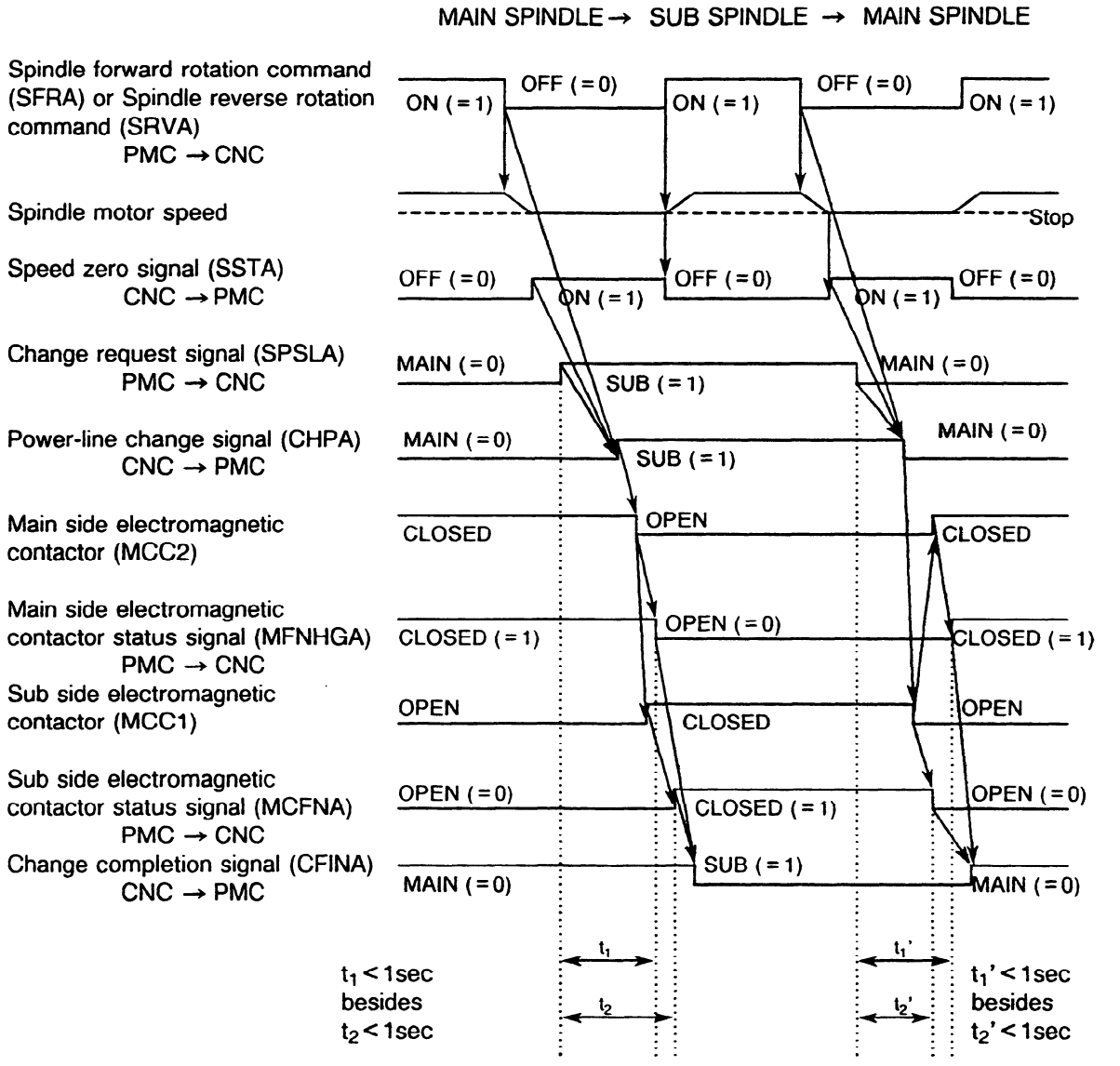
At changing the spindle, it is necessary both that the motor power is off and that the motor is stopping.
This signal is used for confirming whether the motor is stopping.
Please set off the spindle rotation command (SFR/SRV) and the spindle orientation command (ORCM) at changing the spindle, though it is checked wheteher the motor power is off or not on the spindle side.



9. SEQUENCE

9.1 When the Status of Both Electromagnetic Contactors for the Sub Spindle (MCFNA) and for the Main Spindle (MFNHGA) is Confirmed on the Spindle Side and the Spindle Selector Control Works

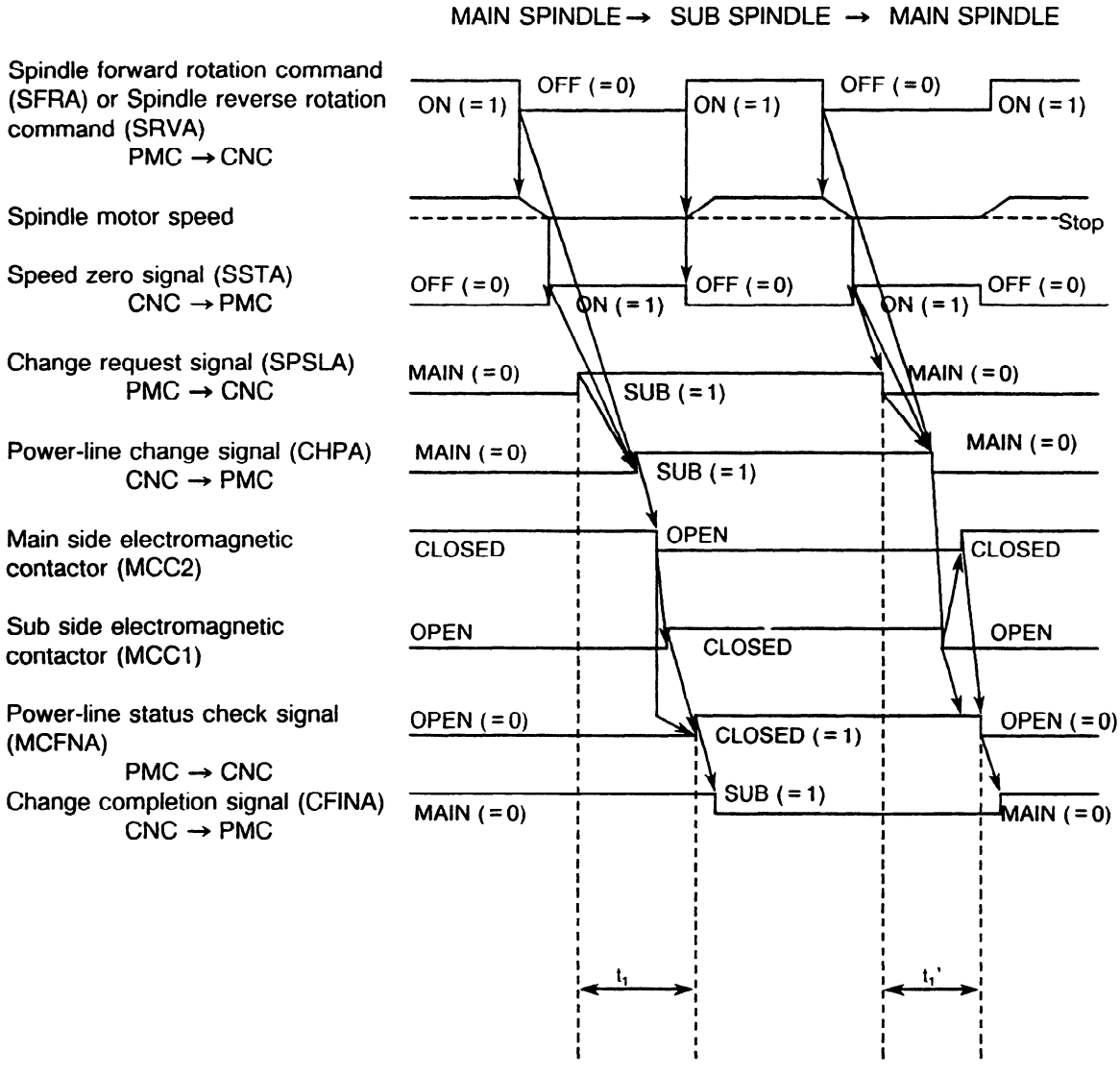
(Parameter NO.6514 #2 = 1 (FS0))
(Applied ROM series and edition number : 9A11/H, 9A21/F, 9A50/H version or later)



If the electromagnetic contactor status check signals for the main spindle (MFNHGA) and for the sub spindle (MCFNA) do not change within 1 second after the change request signal (SPSLA) is changed, the alarm occurs.

9.2 When the Spindle Selector Control Works by Confirming Only the Power-line Status Check Signal (MCFNA)

(For parameter NO.6514 #2 = 0) (FS0)



(Note) Because there are electromagnetic contactor operation delays etc. when checking electromagnetic contactor MCC1, MCC2 selection conditions (see Section 6.2) in electromagnetic contactor MCC1 (see PMC and switching unit contact details) only, auxiliary contacts make sure that there is a minimum time lag of 50 msec between operating the MCC1, MCC2 switch and changing the power cable condition verification signal (MCFN) with the power cable switching cable (CHP).

If the power-line status signal (MCFNA) doesnot change within 1 second after the change request signal (SPSLA) is changed, the alarm occurs.

10. ALARM RELATED TO SPINDLE SELECTOR CONTROL

10.1 Spindle Selector Control Sequence Alarm

(1) Alarm explanation

At parameter setting (NO.6514 #2 = 1) that both electromagnetic contactors for the main spindle and for the sub spindle are confirmed, if the electromagnetic contactor status check signals for the main spindle (MFNHGA) and for the sub spindle (MCFNA) do not change within 1 second after the change request signal (SPSLA) is changed, the alarm occurs.

At parameter setting (NO.6514 #2 = 0) that only the power-line status check signal (MCFNA) is confirmed, if the power-line status check signal (MCFNA) doesnot change within 1 second after the change request signal (SPSLA) is changed, the alarm occurs.

(2) Alarm display

It is displayed on 7 segment-LED of the spindle amplifier as | AL-15 |.

10.2 Power-line Status Abnormal Alarm

(Applied ROM series and edition number : 9A11/H, 9A21/F, 9A50/H version or later)

(1) Alarm explanation

It is always checked whether the change request signal (SPSLA) and the status of power line are corresponding. If they do not correspond for 10 seconds or more, the alarm occurs.

(2) Alarm display and the internal status display at the alarm

When this alarm occurs, the following alarm and the internal status at the alarm occurrence are alternately displayed on 7-segment-LED of the spindle amplifier.

Alarm display | AL-55 | and internal status

	*4	*3	*2	*1

at the alarm occurrence are alternately displayed.

Meaning of the displayed internal status is as follows.

*1: It displays which parameter was used at the alarm occurrence, for the main spindle or for the sub spindle.

0: The motor was controlled by the parameter for the main spindle.
1: The motor was controlled by the parameter for the sub spindle.

*2: It displays the sub spindle side electromagnetic contactor status signal (MCFNA) at the alarm occurrence for parameter NO. 6514 #2 = 1 (FS0).
(At parameter NO. 6514 #2 = 0 (FS0), the power-line status check signal is displayed.)

0: The sub spindle side electromagnetic contactor status signal MCFNA was "0" (Open).
(At parameter NO. 6514 #2 = 0 (FS0), the power-line status check signal MCFNA was "0".)
1: The sub spindle side electromagnetic contactor status signal MCFNA was "1" (Closed).
(At parameter NO. 6514 #3 = 0 (FS0), the power-line status check signal MCFNA was "1".)

*3: It displays the main spindle side electromagnetic contactor status signal (AXHGA) at the alarm occurrence for parameter NO. 6514 #2 = 1 (FS0).
(At parameter NO. 6514 #2 = 0 (FS0), this display is invalid.)

0: The main spindle side electromagnetic contactor status signal AXHGA was "0" (Open).
1: The main spindle side electromagnetic contactor status signal AXHGA was "1" (Closed).

*4: It displays the change request signal (SPSLA) at the alarm occurrence.

0: The main spindle side was selected.
1: The sub spindle side was selected.

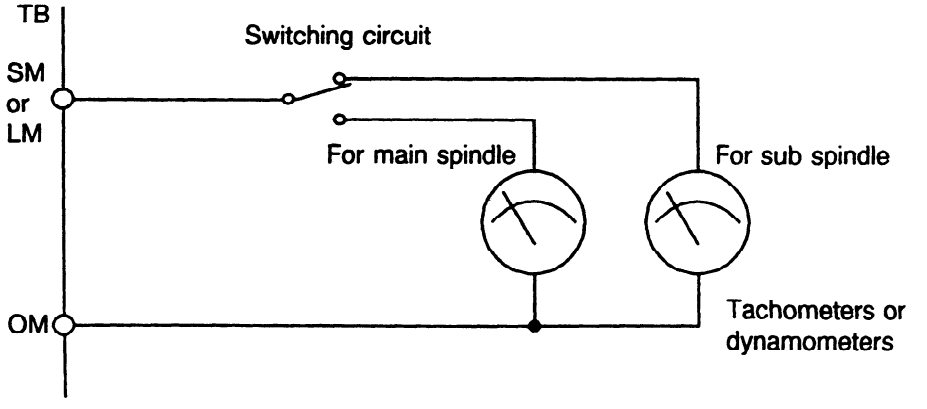
11. CAUTIONS IN USE

(1) The magnetic contact for switching the power line must have an adequate capacity for the AC spindle servo unit.
The example given below shows the model codes of Fuji Electric Co., Ltd.

Applicable AC spindle servo unit	Rated current for 30 min. amplification (A)	Magnetic contactor	
		Model code	Flowing current (A)
1S	13.4	SC-4-0	22
2S	27	SC-1N	50
3S	30	SC-1N	50
6S	35	SC-1N	50
8S	48	SC-2N	60
12S	63	SC-2SN	80
15S	84	SC-3N	100
18S	95	SC-4N	135
22S	111	SC-5N	150
26S	133	SC-6N	150
30S	153	SC-7N	200
40S	183	SC-8N	260

(2) To suppress electrical noise generated while the magnetic contact switches power lines, use a surge absorber containing resistors and capacitors.

(3) The indicated voltages for the speedometer and dynamometer of the main spindle may differ from those of the subspindle. In this case, switch between the tachometers or dynamometers for the main spindle and subspindle as follows.



XVII. SWITCHING UNIT

1. GENERAL

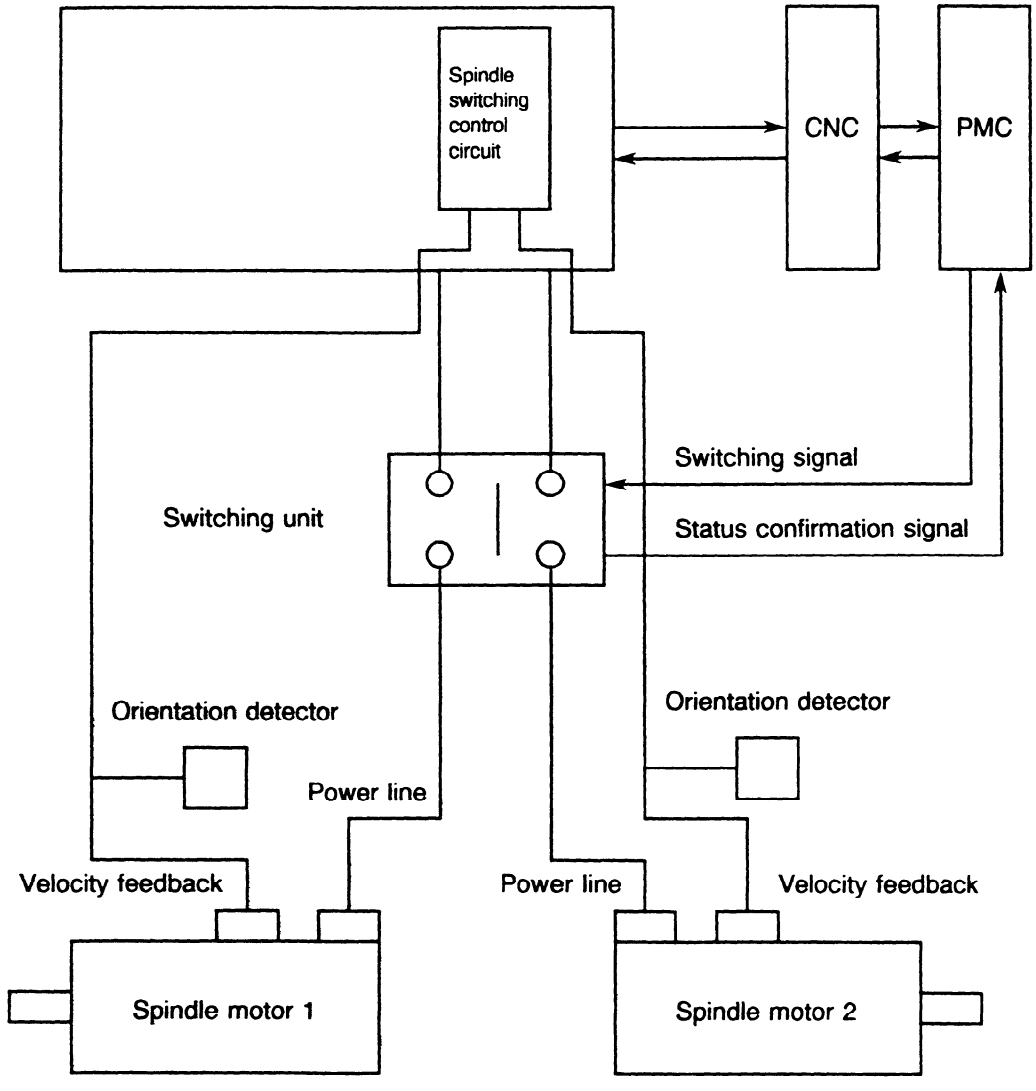
The switching unit uses an electromagnetic contactor outside the servo unit to switch power lines for spindle switching control for two motors or for output switching control for a motor in the following cases:

(1) Switching a power line from one motor to another motor (spindle switching control)
(2) Switching a power line for a motor which has two types of windings (output switching control)

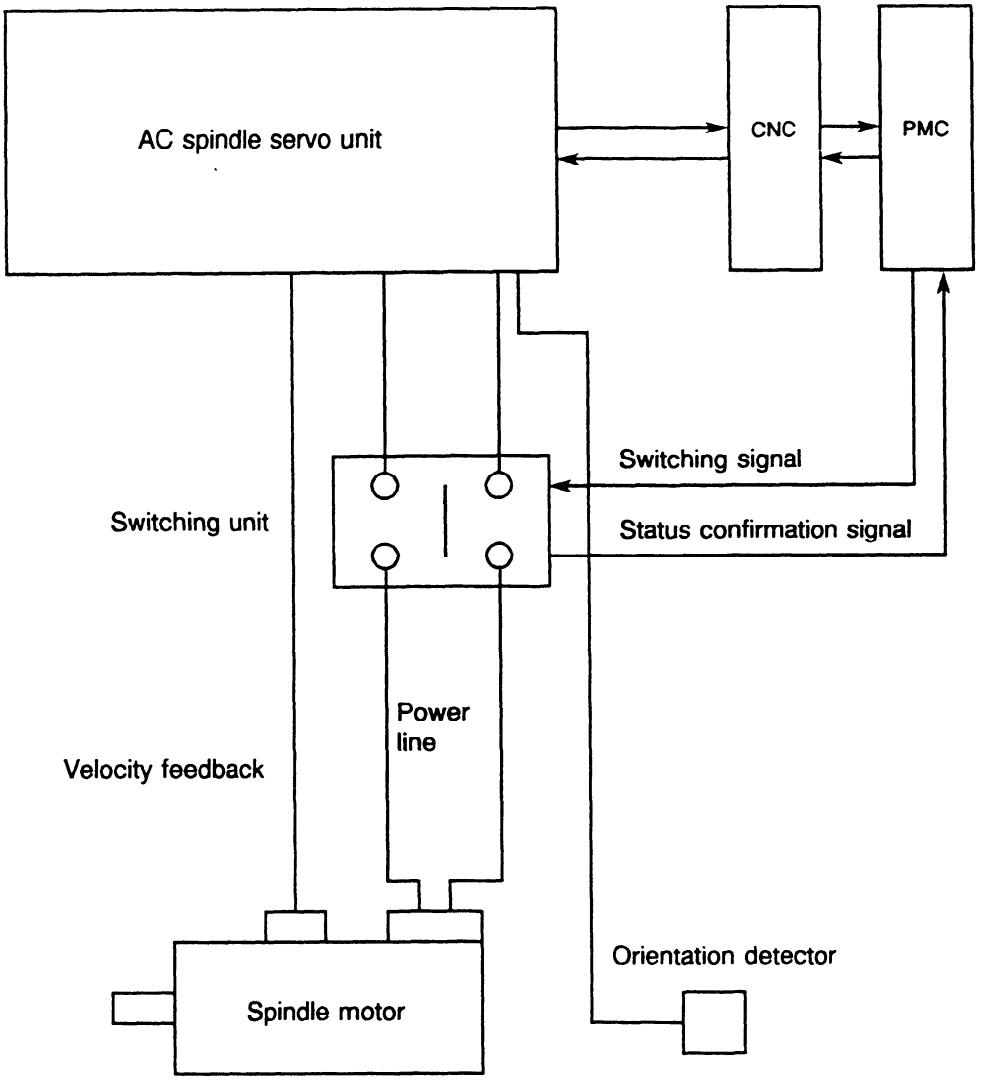
2. CONFIGURATION

2.1 Spindle Switching Control

AC spindle servo unit



2.2 Output Switching Control



3. ORDER DRAWING NUMBER

Ordering code No.	Application	Applicable amplifier
A06B-6059-K034	For spindle switching control and for output switching control (type B)	Models 0.5S to 12S
A06B-6059-K035	For output switching control (type A)	
A06B-6059-K036	For spindle switching control and for output switching control (type B)	Models 15S to 26S
A06B-6059-K037	For output switching control (type A)	

(Note) Type A: Switching the 人 - △ connection for the motor coil
Type B: Switching the 人 - 人 connection for motor coil

4. SPECIFICATIONS

- Specifications of electromagnetic contactors

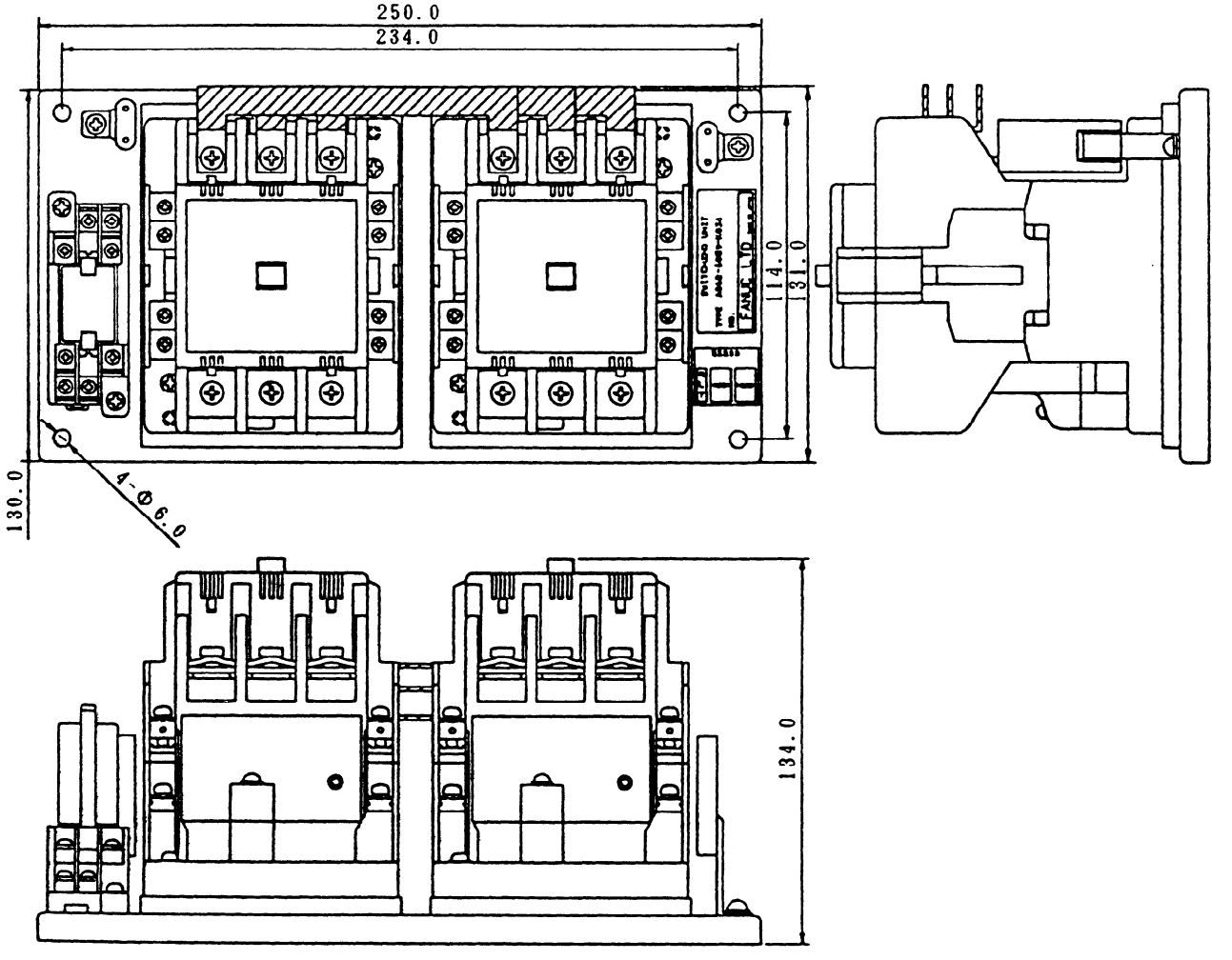
FANUC purchase code No.	A58L-0001-0306 (SC-3N manufactured by Fuji Electric)		A58L-0001-0312 (SC-6N manufactured by Fuji Electric)	
Rated operating voltage	220 V		220 V	
Rated operating current	65 A		125 A	
Current capacity for the closed circuit and shut-off	Closed circuit	780 A	Closed circuit	1500 A
	Shut-off	650 A	Shut-off	1250 A
Frequency of switching operation	1200 times/hour or more			
Life expectancy of the switching operation	Mechanical	5 million times or more		
	Electrical	1 million times or more		
Rating of the electromagnetic operation coil	200/220 V, −15%, +10%, 50/60 ± 1 Hz			
Applicable AC spindle servo unit	Models 0.5S to 12S		Models 15S to 26S	

- Specifications of the relay

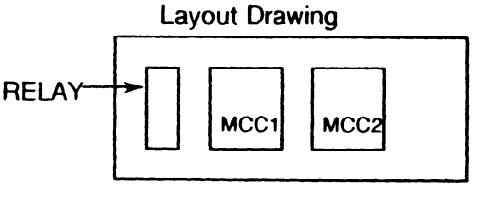
FANUC purchase code No.	A58L-0001-0307 (LY2-D manufactured by Omron)
Rated voltage	24 V ± 10%
Rated current	36.9 mA

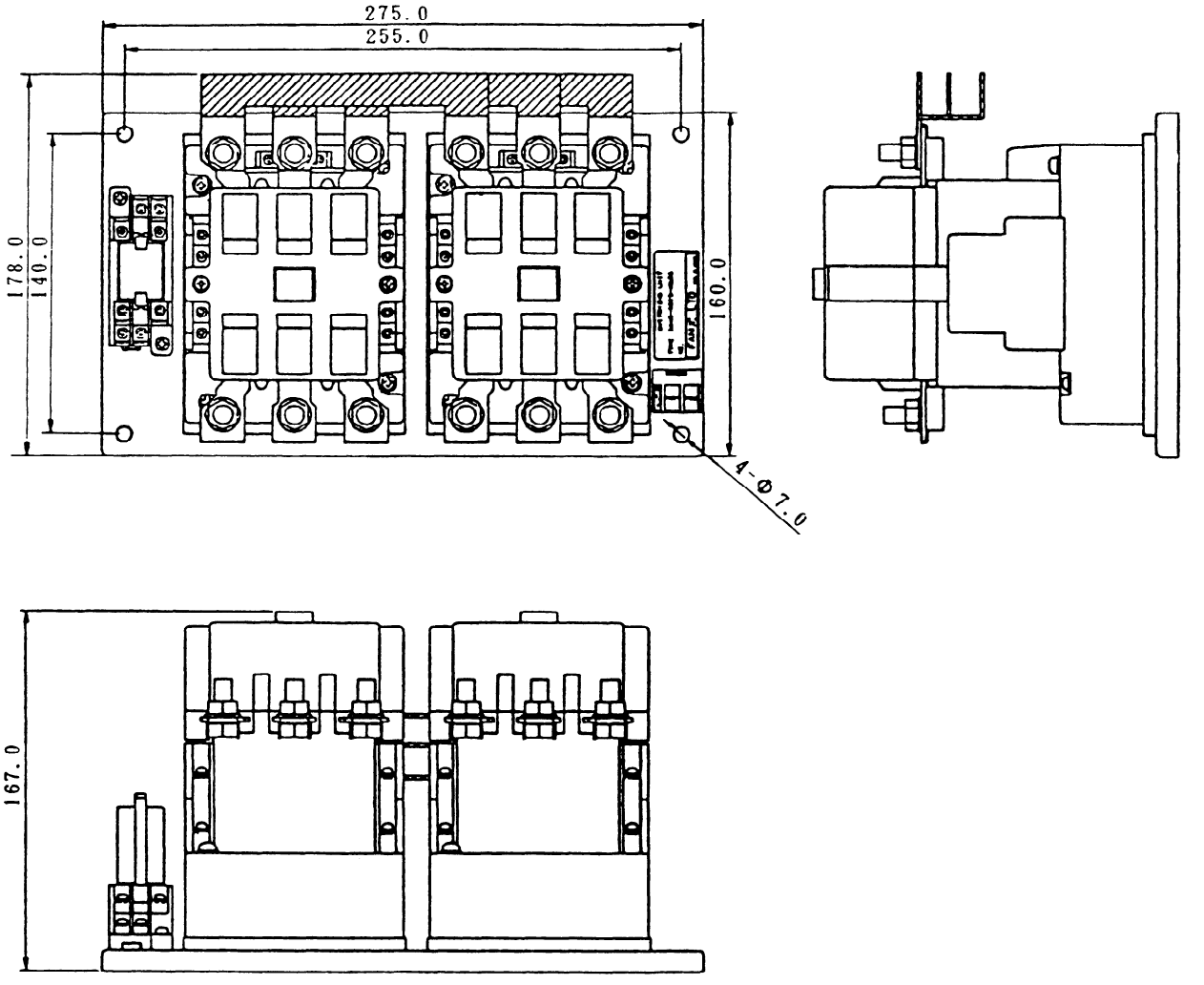
5. EXTERNAL DIMENSIONS AND DIMENSIONS FOR MOUNTING

5.1 External Dimensions and Dimensions for Mounting the Switching Unit for the Spindle Switching Control and Output Switching Control (Type B: 人- 人 Connection)



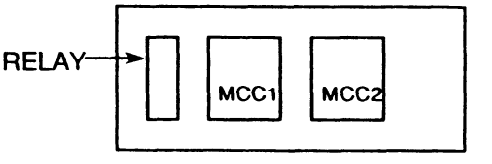
A06B-6059-K034
Fig. 5.1 (a)



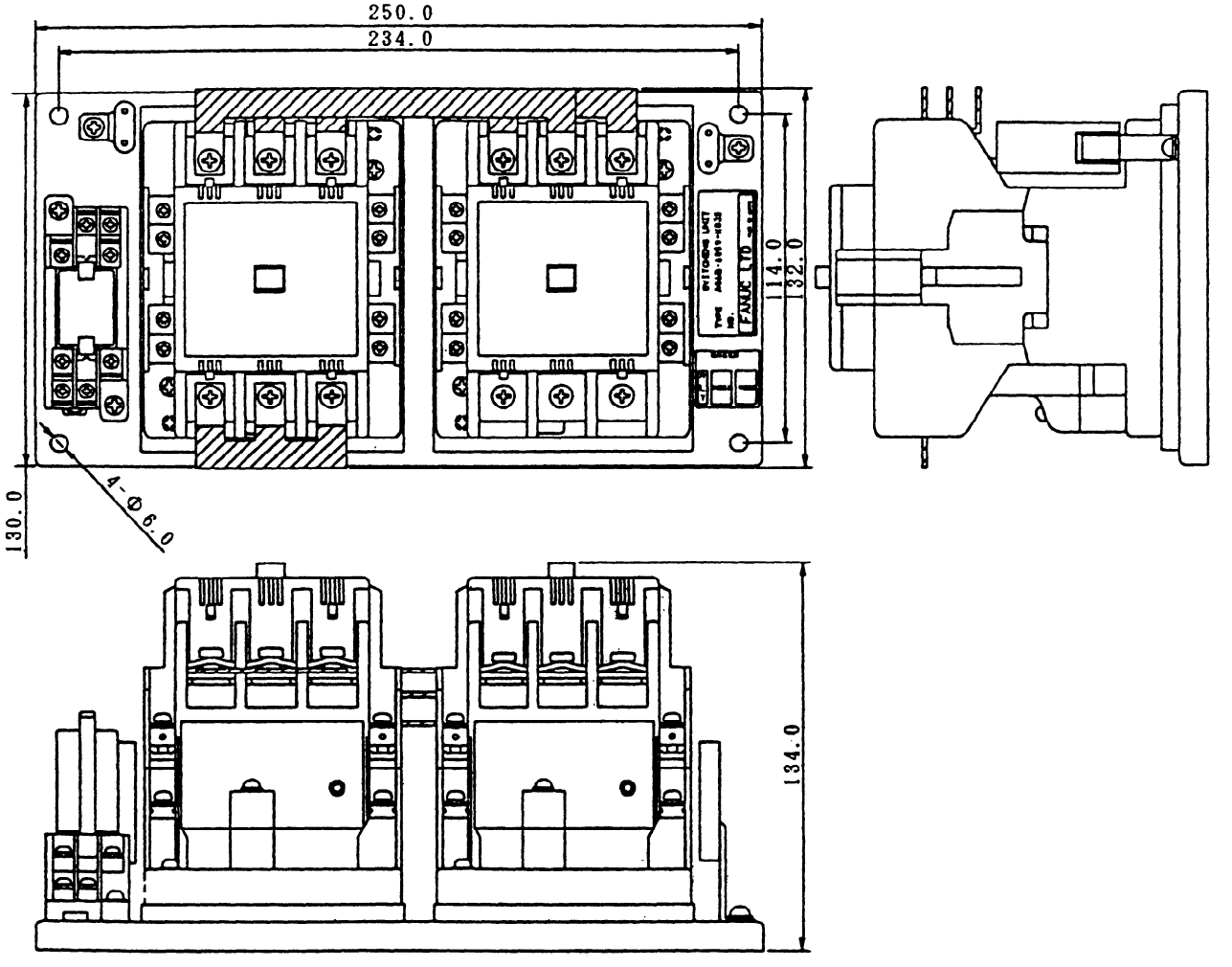


A06B-6059-K036
Fig. 5.1 (b)

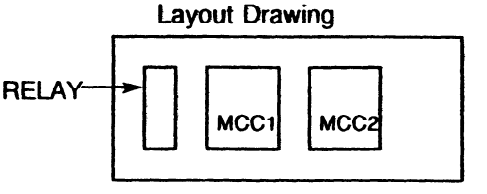
Layout Drawing

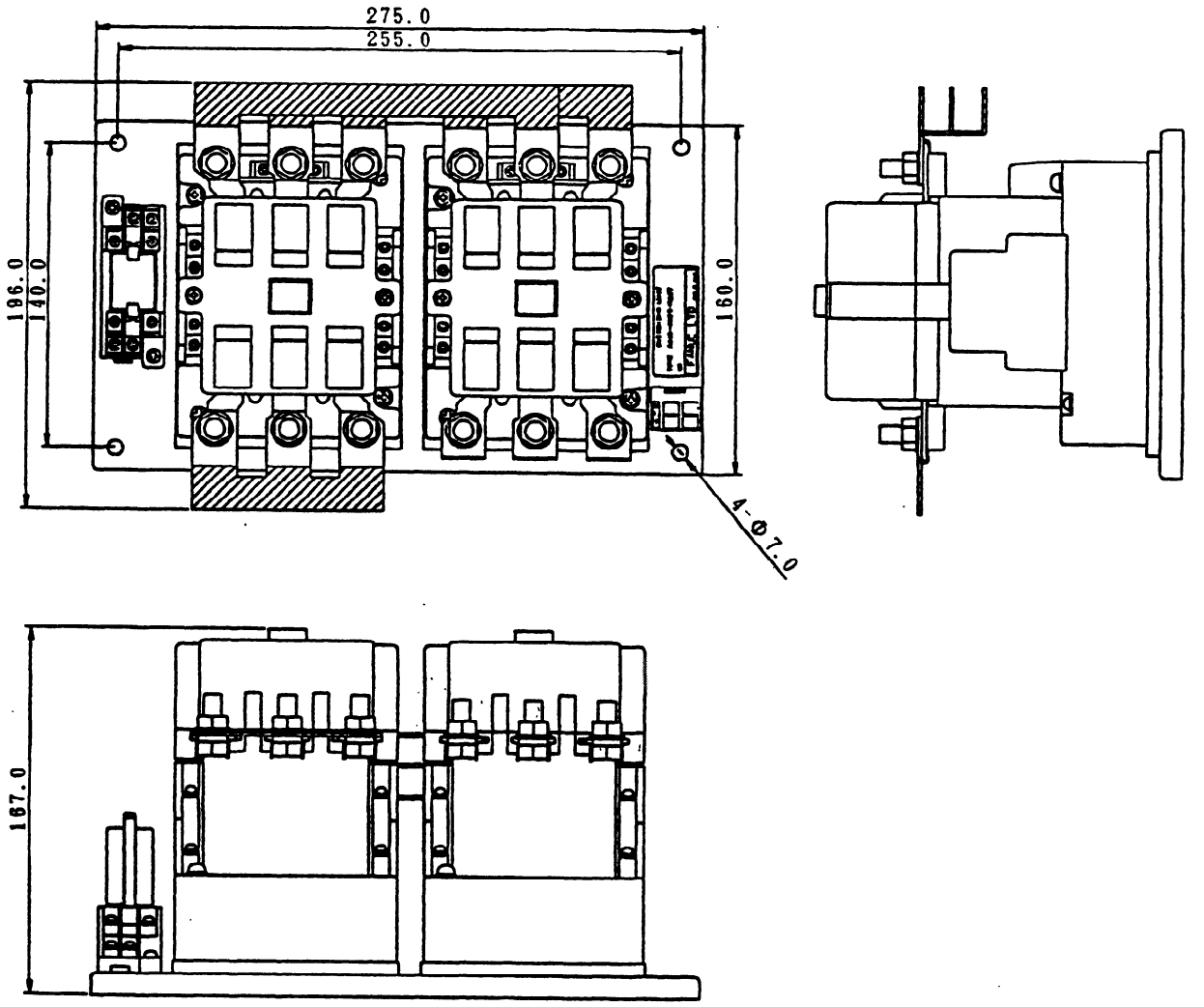


5.2 Outside Dimensions and Dimensions for Mounting the Switching Unit for Output Switching Control (Type A: 人-Δ Connection)



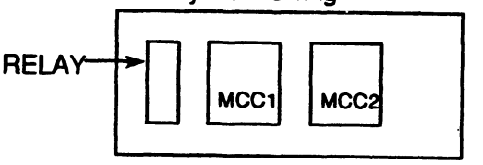
A06B-6059-K035
Fig. 5.2 (a)





A06B-6059-K037
Fig. 5.2 (b)

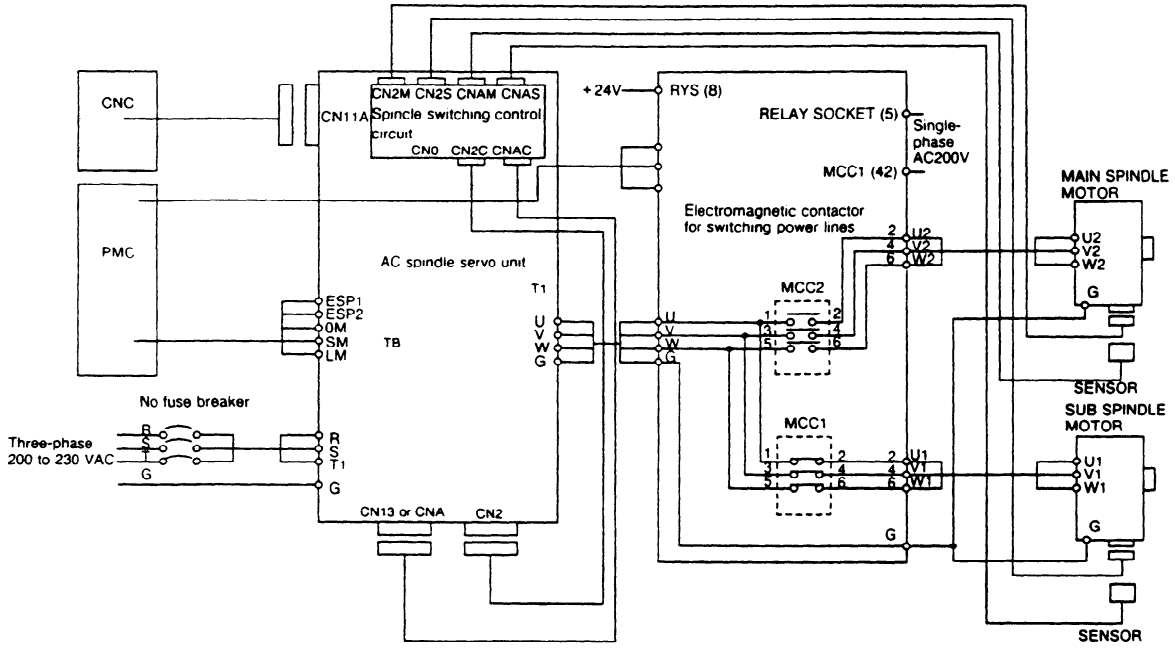
Layout Drawing



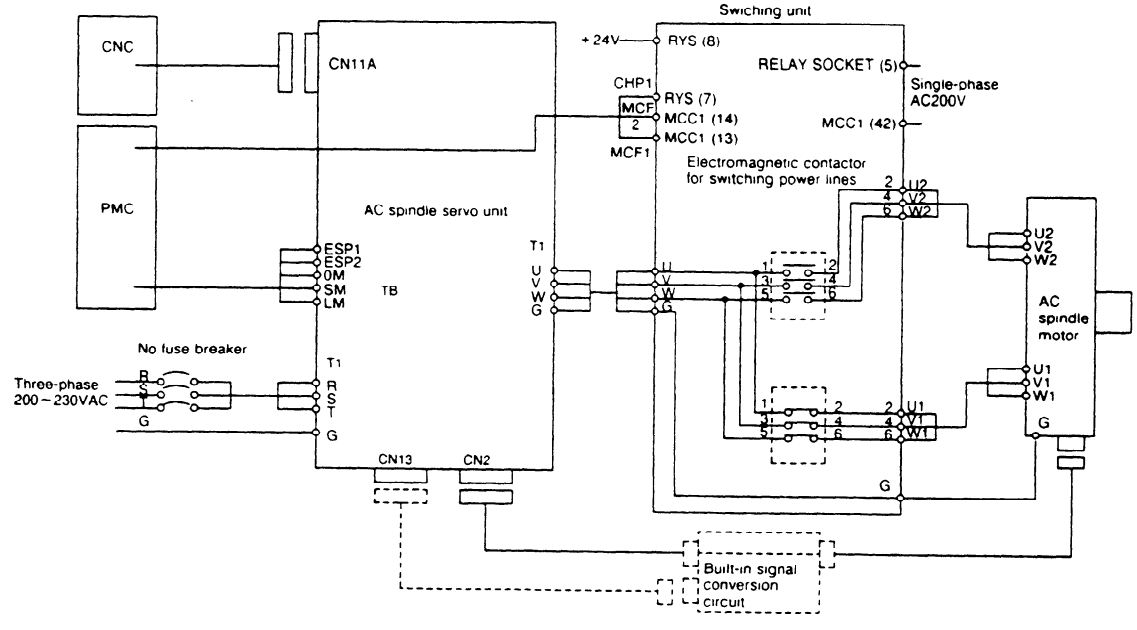
6. CONNECTION

6.1 Complete Schematic Drawing

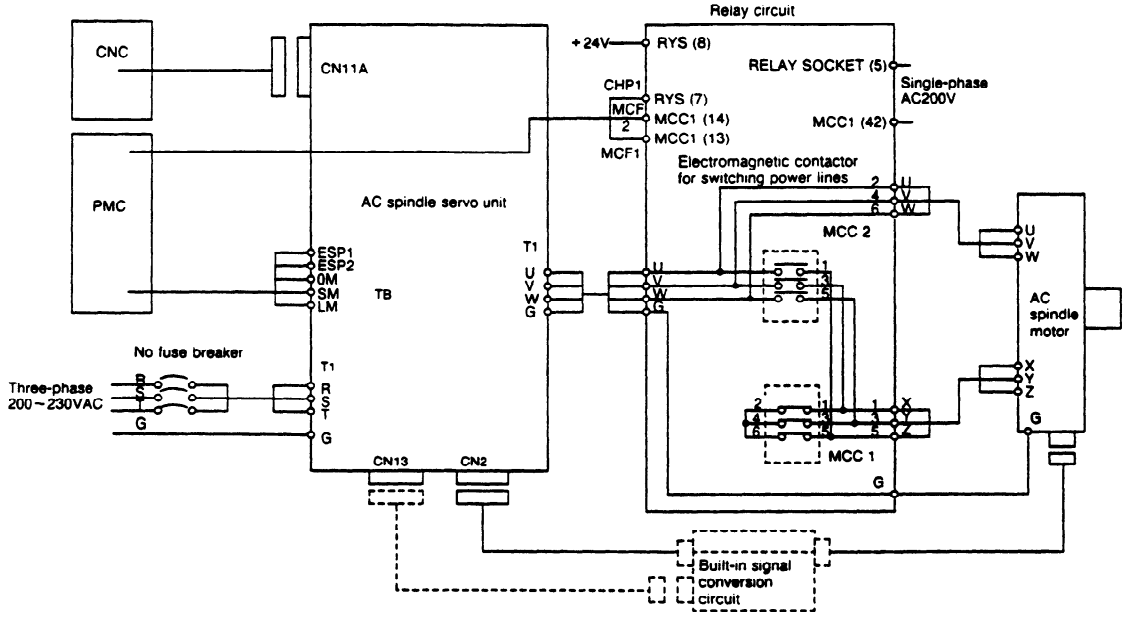
6.1.1 Schematic drawing of the switching unit for spindle switching control



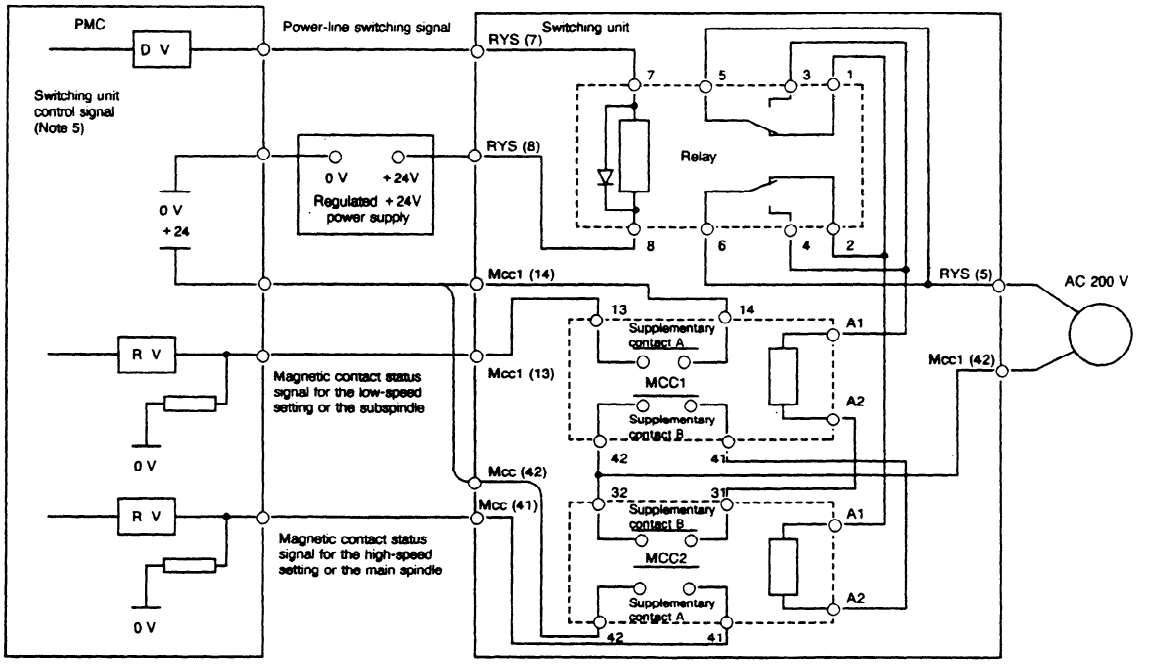
6.1.2 Schematic drawing of the switching unit for output switching control (type A: 人- Δ connection)



6.1.3 Schematic drawing of the switching unit for output switching control (type B: 人-人 connection)



6.2 Detailed Diagram of Connections between the PMC and the Switching Unit



(Note 1) This figure shows an example of connections between the PMC and the switching unit with one driver and two receiver for switching. (In the above figure, 200 VAC power is not supplied.)

(Note 2) For connections between the main contacts of an electromagnetic contactor and a power line, see Section 6.1, "Complete Schematic Diagram."

(Note 3) Connect the PMC to the switching unit at the screw terminals of the electromagnetic contactor and relay socket with screws.

(Note 4) For information on interface signals, see Parts XV and XVI.

(Note 5) The table below indicates the relationship of the switching unit control signal with the ON/OFF states of MCC1 and MCC2.

Swithing unit control signal	MCC1	MCC2
OFF	OFF	ON
ON	ON	OFF

7. CAUTION IN USE

(1) Install the switching unit under the same conditions as for a spindle servo unit.

Conditions for installing the switching unit

- Ambient temperature:
  0 to 55°C for the unit
  0 to 45°C for the cabinet
- Ambient humidity: 95%RH or less, no condensation
- Vibration: 0.5 G or less during operation
- Ambient air: Corrosive, conductive mist or water drops must not come into direct contact with electronic circuits.

(2) Install the switching unit according to Fig. 7 (a). An inclination of 15 degrees is permitted in the right, left, front, and back.

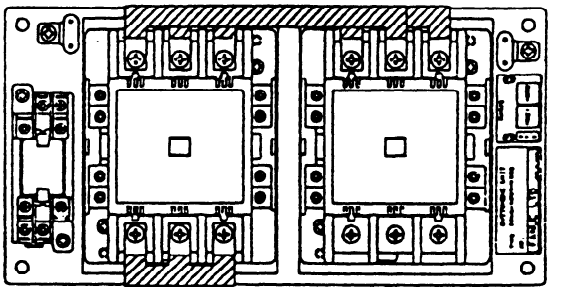


Fig. 7 (a) Standard Installation (for A06B-6059-K035)

(3) It may be necessary to install the unit on its side as shown in Fig. 7 (b), due to wiring or space limitations. The characteristics of the electromagnetic contactor will not be affected, however, the mechanical life of the unit and the number of times the contactor can be opened and closed will be decreased.

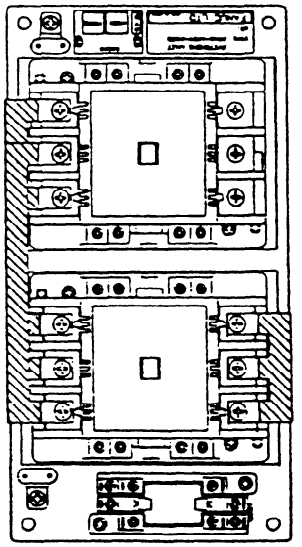


Fig. 7 (b) Non-standard Installation (for A06B-6059-K035)

(4) Leave enough space to prevent arc from affecting other units, as shown in Fig. 7 (c).

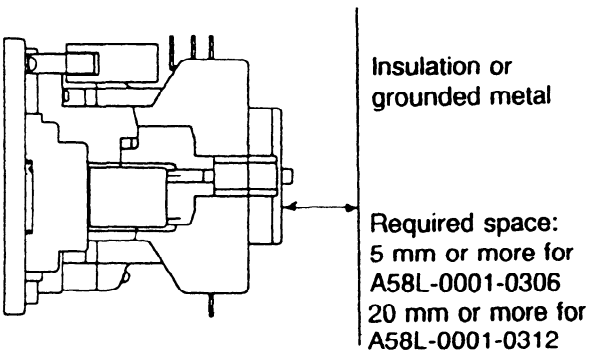


Fig. 7 (c) Required Space

(5) If an electromagnetic contactor is installed incorrectly, contacts may jump at power on or its life may be decreased. If a cable is not connected to the contactor securely, the connected part may generate heat or the cable may loosen and come off, resulting in a serious accident.

(a) Tightening torque

(i) Electromagnetic contactor

Item	Tightening torque (kg · cm)	
	A58L-0001-0306	A58L-0001-0312
MCC main terminal	62.0 (M6.0)	84.0 (M8.0)
MCC supplementary terminal	14.0 (M3.5)	14.0 (M3.5)

(ii) Relay socket

Item	Tightening torque (kg · cm)
Relay socket	14.0 (M3.5)

XVIII. DIFFERENTIAL SPEED CONTROL FUNCTION DESCRIPTION

1. OUTLINE

Differential speed control relatively controls the rotation speed of spindle 2 for the rotation speed of spindle 1.

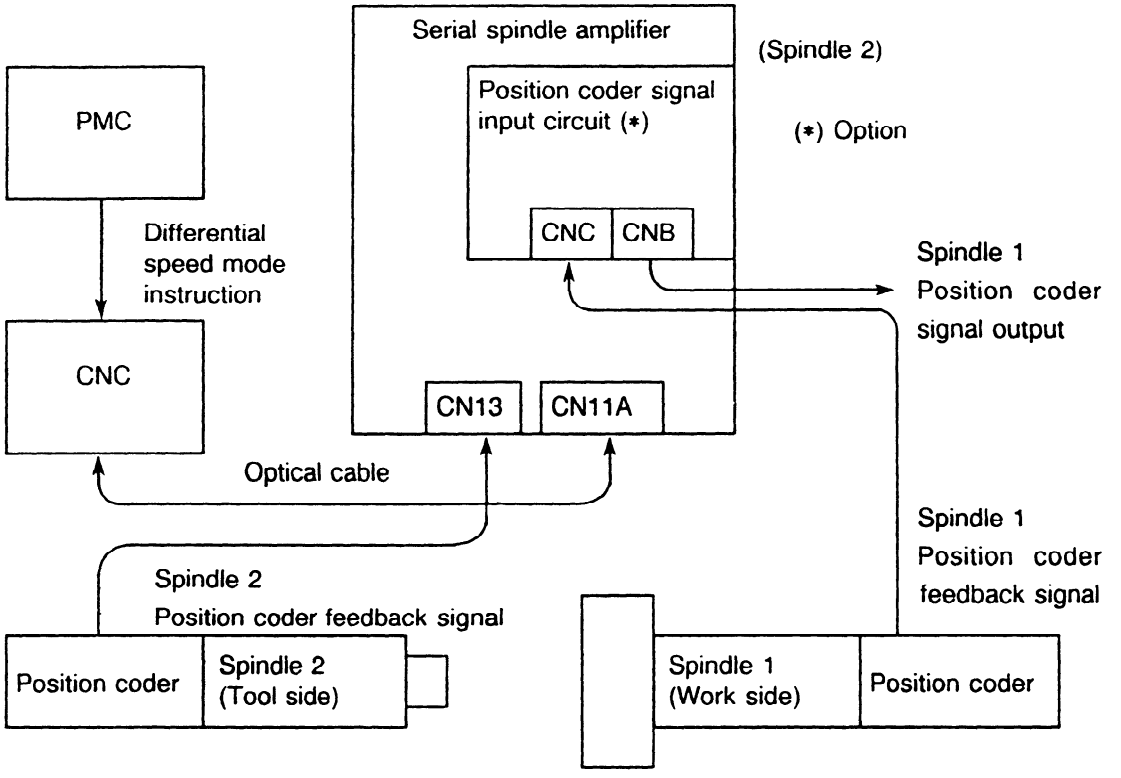
2. CHARACTERISTIC

The Rigid Tap movement can be done without stopping the rotation of WORK (Spindle 1). So far, to do the Rigid Tap, it was necessary to stop spindling it temporarily. It is possible to shorten the time by using this function.
The following optional circuits cannot be used together with the position coder signal input circuit.

Optional circuit unusable with position coder signal input circuit	
Name	Specification drawing number
Spindle switching control circuit	A06B-6064-J701 A06B-6064-J702
Built-in signal conversion circuit for built-in sensor	A06B-6064-J704 A06B-6064-J706
Detection circuit for a high-resolution position coder	A06B-6064-J705
Detection circuit for a high-resolution magnetic pulse coder	A06B-6064-J720 A06B-6064-J721 A06B-6064-J722 A06B-6064-J724 A06B-6064-J725 A06B-6064-J726

3. CONFIGURATION AND ORDER DRAWING NUMBER

3.1 Configuration



3.2 Order Specification of the Option

Classification	Name	Specification	Note
Option	Position coder signal input circuit	A06B-6064-J703 (*)	This option is possible to use for AC spindle servo unit A06B-6064-HXXX#5XX (X means any number) Applicable ROM series · 1S~26S : 9A50 series (H550) · 30S, 40S : 9A21 series (H521) 9A50 series (H550)

(*) The specification 'A06B-6064-J703' is consisted of P.C.B. A16B-1700-0260 and etc.

4. SPECIFICATION OF POSITION CODER SIGNAL INPUT CIRCUIT

4.1 Output Signal

Connector CNB generates the position coder signal received in connector CNC.

4.1.1 Position coder (Connector CNC input signal)

Refer to the item of the position coder in the following specifications.

- See IX. Position Coder Method Spindle Orientation
- 'Connection manual' of CNC of use

4.1.2 Connector CNB output signal

The composition of the output circuit becomes a balance output by AM26LS31. (made of Texas Instruments)

4.2 Range of Operating Temperature

0 to +55°C

5. INPUT/OUTPUT SIGNAL EXPLANATION

5.1 Signal DI (PMC → CNC)

Differential speed mode instruction DEFMDA

[FUNCTION]

Instruct the serial spindle amplifier in the differential speed mode. In this mode, spindle 2 is controlled by the rotating speed of instruction of spindle 2 + spindle 1

[MOVEMENT]

Spindle 2 is controlled in the differential speed mode in the state of HIGH and released in the state of LOW.

Address of PMC

PM	0C	15	16	#7	#6	#5	#4	#3	#2	#1	#0
G114	G231	G229	G072					DEFMDA			

DEFMDA = 0: Ordinary mode

1: Differential speed mode

5.2 The Remarks Concerning Differential Speed Control Function

(1) High resolution magnetic pulse coder can't be used when you use this differential speed control function.

(2) Unite position coders by 1:1 against Spindle 1

(3) Use the position coders of the signal 1024p/rev or 512p/rev output. Terms "5.3" describes about the setting of this parameter.

(4) At the differential speed Rigid Tap, a rotating speed of spindle 2 (instructed speed at Rigid Tap + rotating speed of Spindle 1) must not be over the maximum speed range.

In the range where the rotating speed is high, the output torque of the motor becomes small generally. For that set acceleration/deceleration time constant at the Rigid Tap more largely than usually.

(5) Refer to the item of the Rigid Tap of the operator's manual of CNC of use concerning the Rigid Tap.

5.3 Serial Spindle Parameter Related to Differential Speed Control Function

When you do the differential speed Rigid Tap, follow spindle 2 in setting a necessary parameter for a usual Rigid Tap in addition to the following parameters.

(Note) 'The second spindle' means the spindle which is controlled by the Serial AC Spindle Servo Unit secondly tied to the first one in a row (connector CN11B). And the meaning of 'The second spindle' is different from 'Spindle 2' which is controlled by a differential speed.

Parameter No. (the lower: The second spindle (see:*))

PM 0C 15 16

3000 6500 3000 4000
6640 3140

DEFRTO	DEFDRT	DEFMOD			POSC1		ROTA1
#7	#6	#5	#4	#3	#2	#1	#0
0	0	0	0	0	0	0	0

Standard set value:

ROTA 1 Relation of rotating direction of spindle and spindle motor

0: The spindle and the motor: the same direction

1: The spindle and the motor: reverse-direction

Judge the rotating direction of a motor according to the one which sees from the direction of the shaft of the motor.

POSC1 Mounting direction of position coder

0: When spindle and position coder are installed in the same direction of rotation.

1: When spindle and position coder are installed in reverse-direction of rotation.

Judge the rotating direction of the position coder according to the one which sees from the shaft side of the position coder.

DEFMOD Presence of differential speed mode function

0: Differential speed mode is provided

1: Differential speed mode is not provided

DEFDRT Setting of direction of differential speed

0: Rotate in the same direction of feedback signal

1: Rotate in the opposite direction of feedback signal

DEFRTO Setting of output pulse of position coder (for Spindle 1)

0: 1024p/rev.

1: 512p/rev.

Parameter No. (the lower: The second spindle (see:*))

PM	0C	15	16								
3001	6501	3001	4001						POSC2		
	6641	3141									
				#7	#6	#5	#4	#3	#2	#1	#0
Standard set value:				0	0	0	0	0	1	0	1

POSC2 Setting of use and unuse of the position coder

0: Unuse

1: Use (Set this parameter when Rigid Tap function is provided)

Parameter No. (the lower: The second spindle (see:*))

PM	0C	15	16								
3002	6502	3002	4002			SVMDRT					
	6642	3142									
				#7	#6	#5	#4	#3	#2	#1	#0
Standard set value:				0	0	1	0	0	0	0	0

SVMDRT Setting function of rotating direction signal (SFR/SRV) at servo mode (Rigid Tap/Cs axis control)

0: Have the function to decide the rotating direction

By movement command of +

Spindle rotate in the direction of CCW at SFR = ON

Spindle rotate in the direction of CW at SRV = ON

1: Lost the function to decide the rotating direction

SFR/SRV signal lost function to decide a direction

The signal becomes only a function to turn on excitation of the spindle motor.

By movement command of +

Spindle rotate in the direction of CCW at SFR = ON or SRV = ON.

Parameter No. (the lower: The second spindle (see:*))

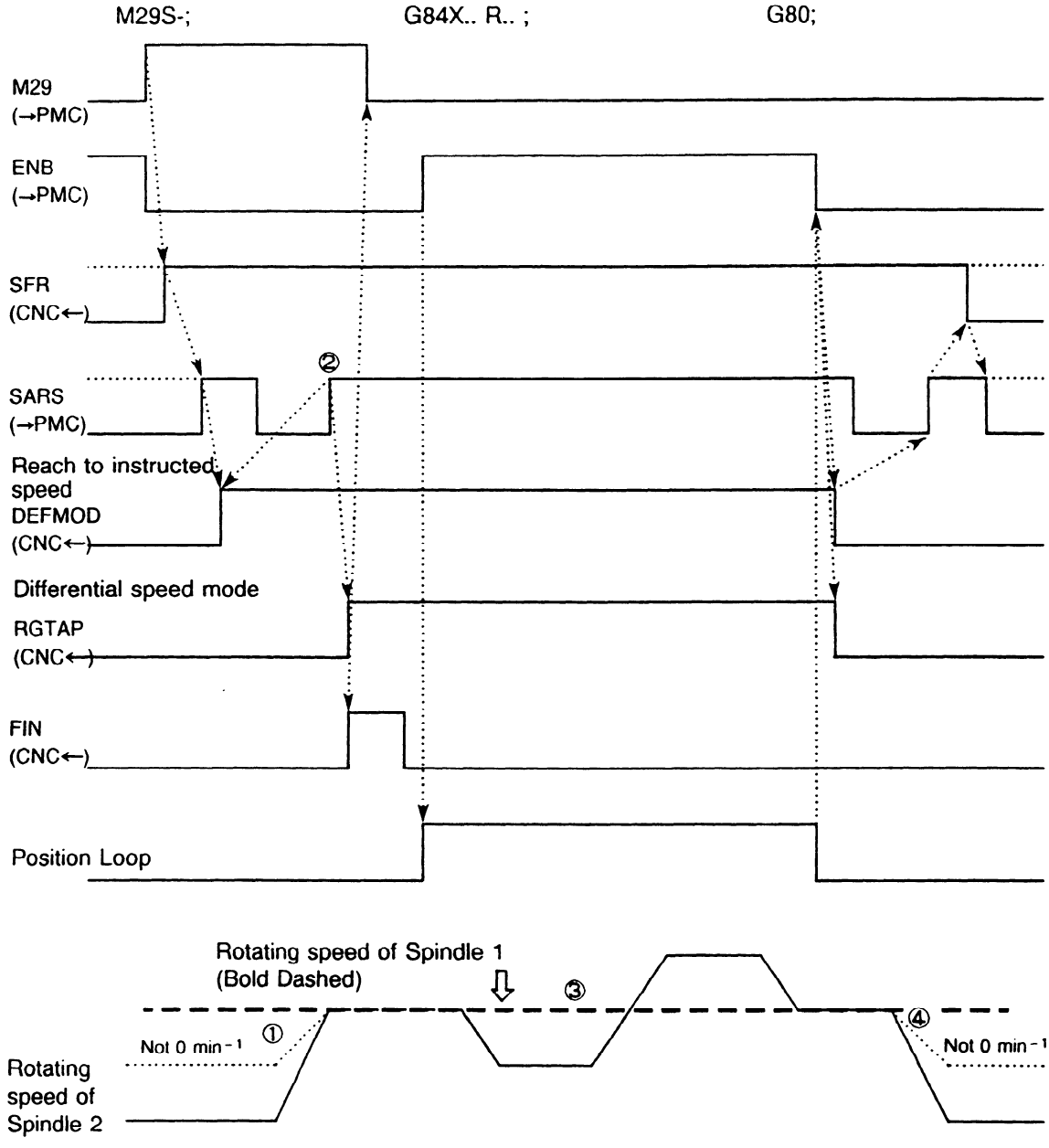
PM	0C	15	16								
3003	6503	3003	4003				PCTYPE				
	6643	3143									
				#7	#6	#5	#4	#3	#2	#1	#0
Standard set value:				0	0	0	0	0	0	0	0

PCTYPE Type (pulse outputs number of one rotation) setting of position coder

0: 1024p/rev.

1: 512p/rev.

5.4 Example of Sequence of Differential Speed Rigid Tap



① When differential speed mode is instructed to Spindle 2, Spindle 2 is accelerated to reach to a speed of Spindle 1. (Solid line indicates the case that the instruction of rotating speed of Spindle 2 is 0 min^{-1})

② After confirming that Spindle 2 reaches to instructed speed, Go to rigid Tap sequences.

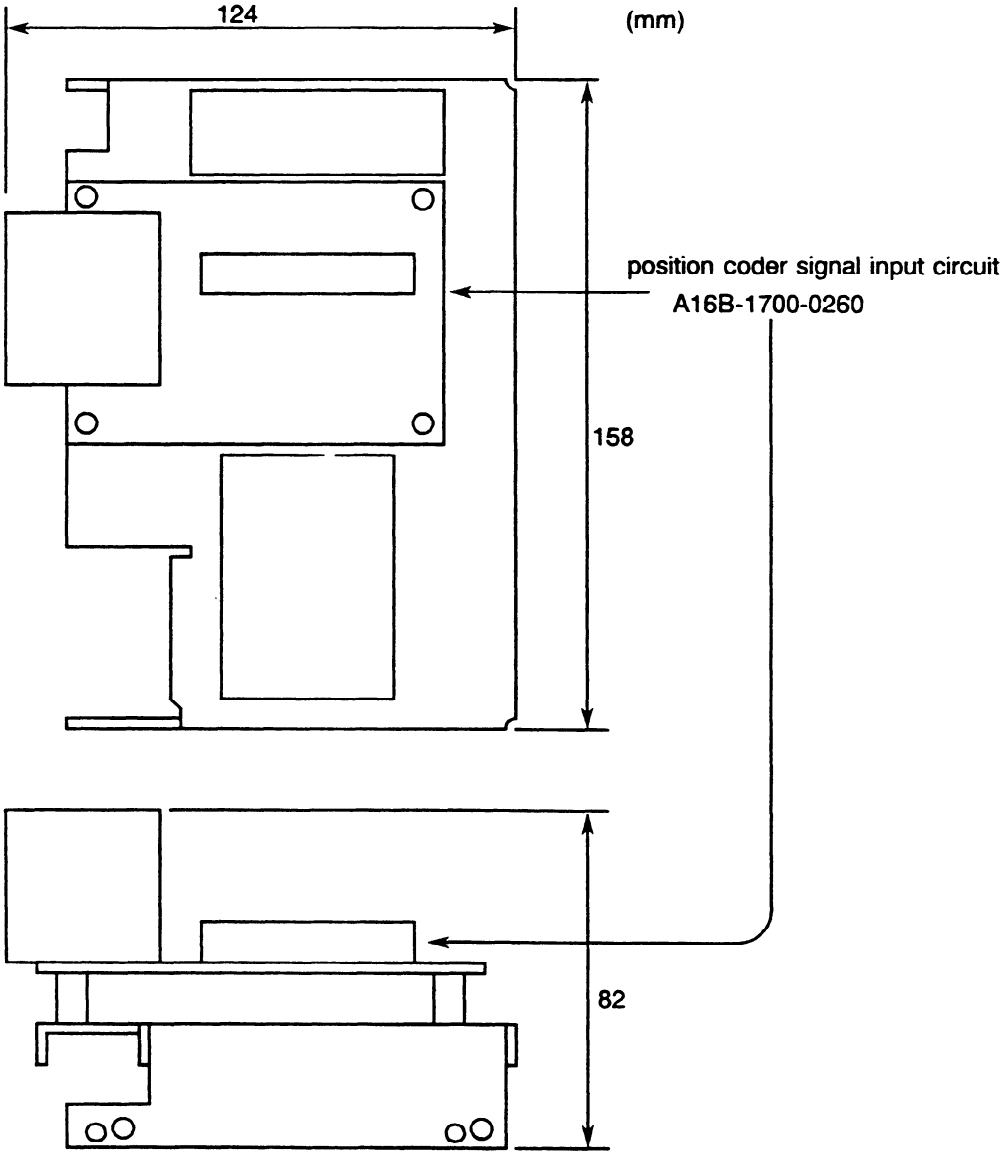
③ Doing Differential speed Rigid Tapping.

④ After finishing Rigid Tap sequences, instruct normal mode (DEFMOD = 0) and, in the case of instruction of speed of Spindle 2 is 0 min^{-1}, Spindle 2 is stopped. (Solid line) If instruction of Spindle 2 is not 0 min^{-1}, Spindle 2 is accelerated to reach to the instruction. (Dashed line)

6. POSITION CODER SIGNAL INPUT CIRCUIT (OPTION) EXTERNAL DRAWING

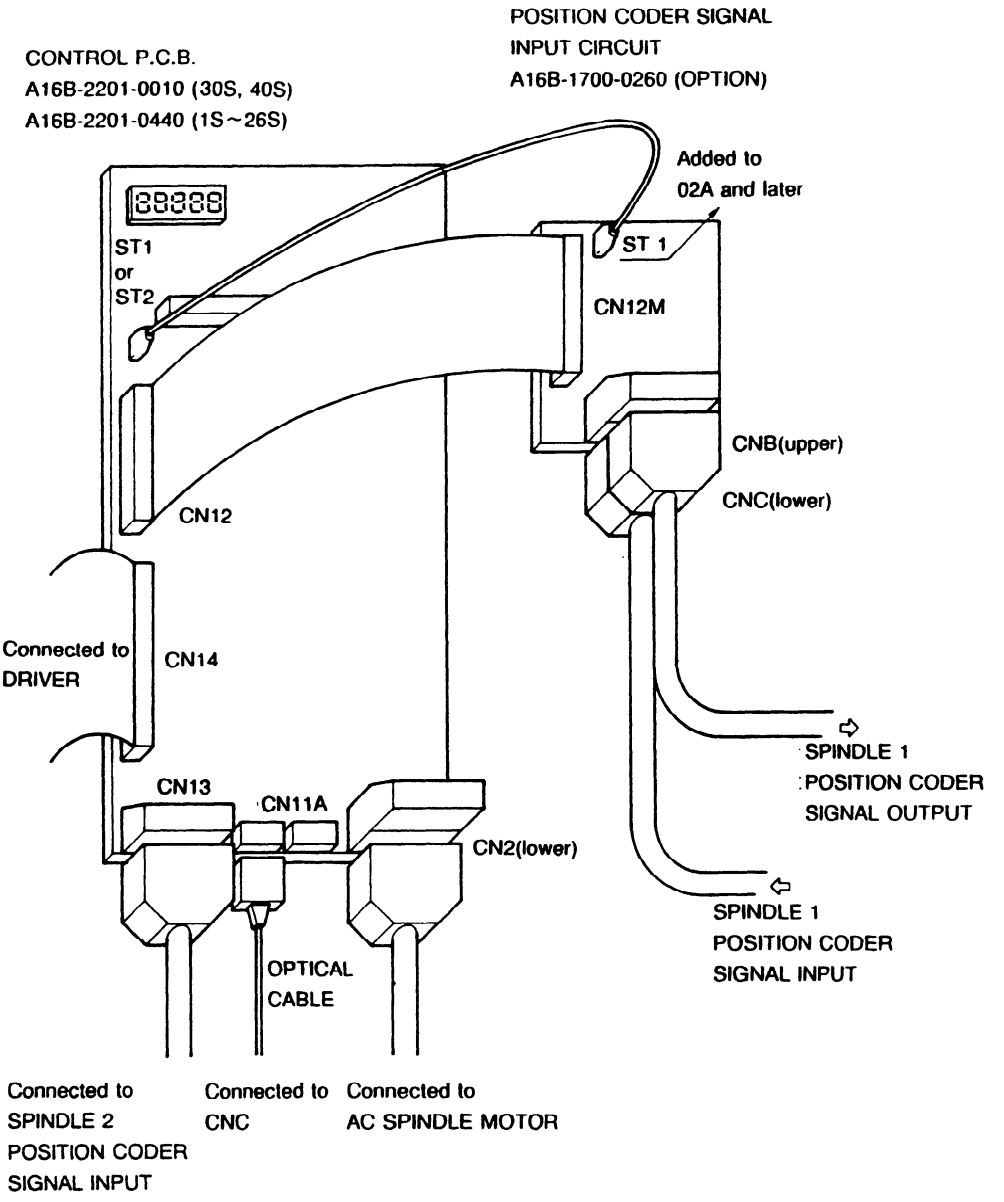
This option is mounted over the control P.C.B unit.

The maximum height of Unit with mounting Position coder signal input circuit
MODEL 1S~26S: 300mm MAX 30S, 40S: 330mm MAX

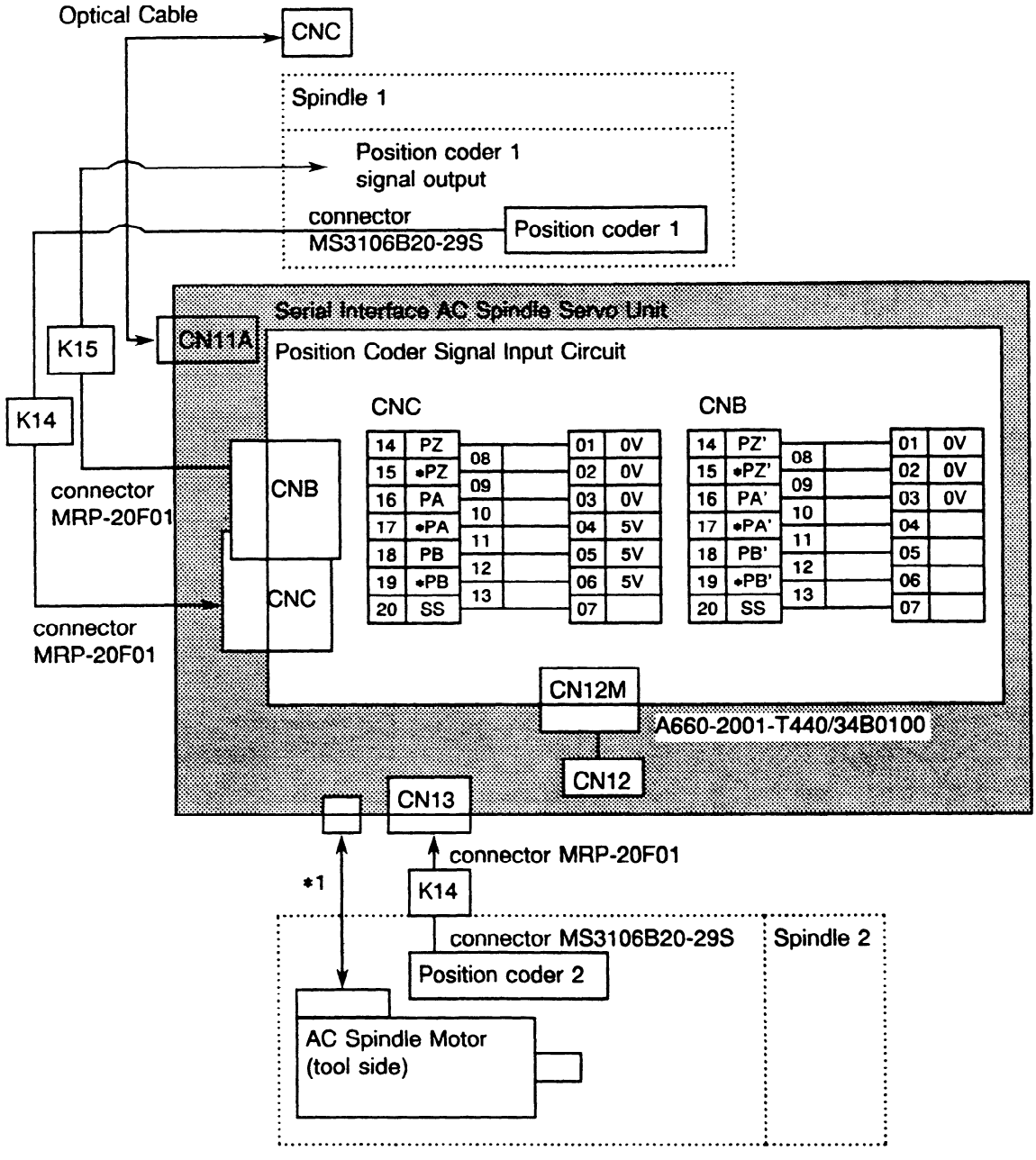


7. CONNECTION

7.1 Cable Withdrawing Figure



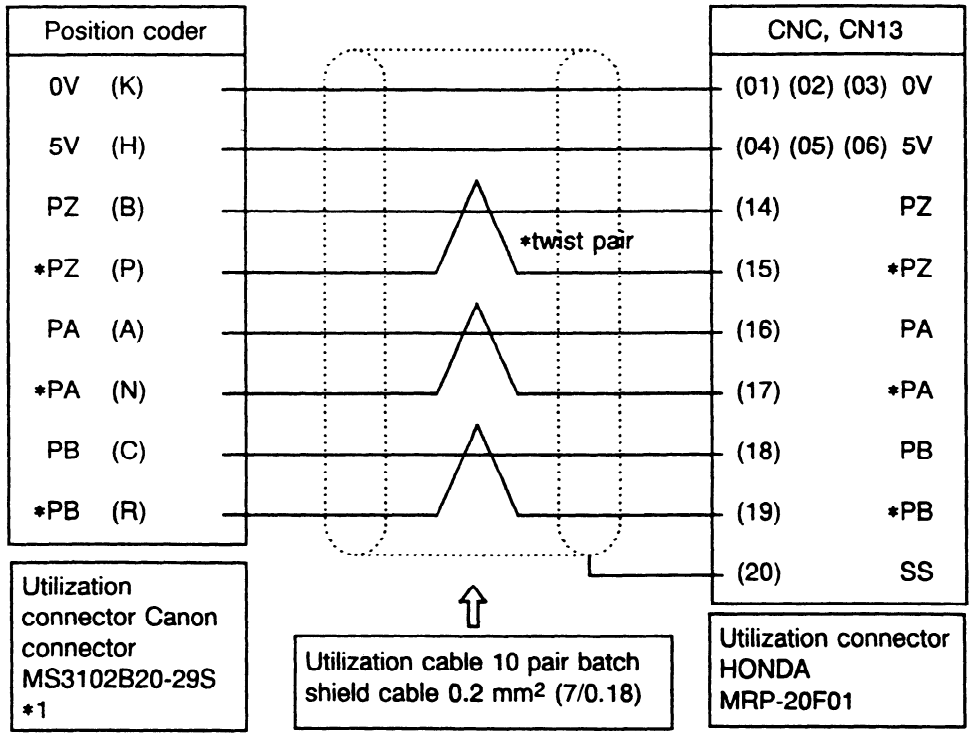
7.2 Connection Chart



(*1) AC Spindle Motor is ordinary connected to AC Spindle Servo Unit with Power line and Velocity feedback cable.

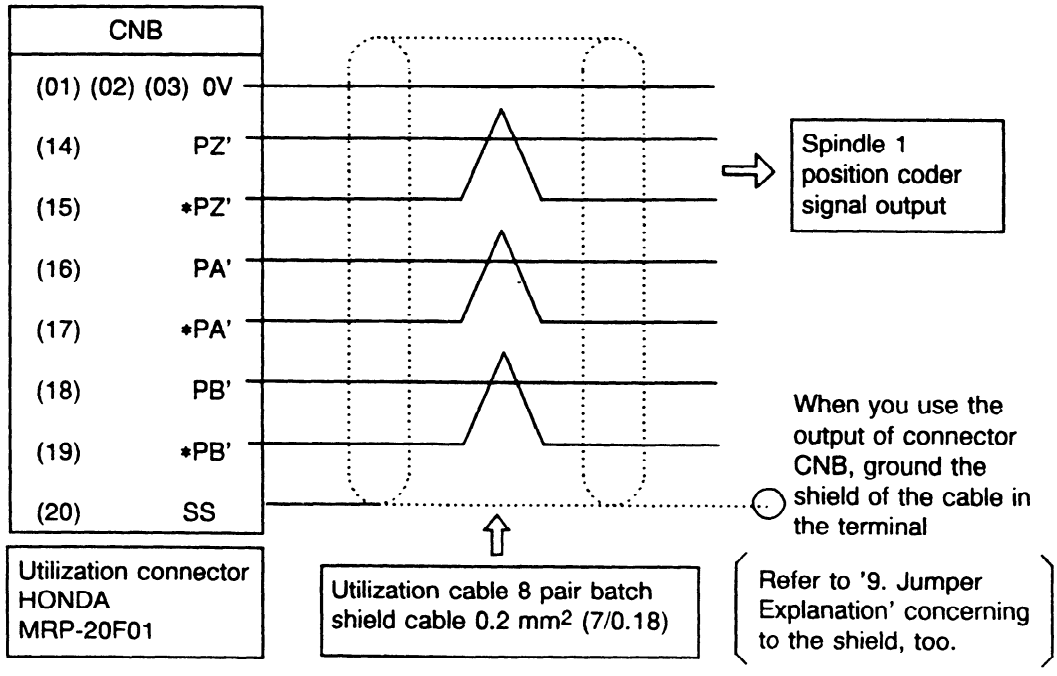
8. CONNECTION DETAIL DRAWING

8.1 Cable Sign K14 : Spindle 1 Position Coder to Position Coder Signal Input Circuit
: Spindle 2 Position Coder to AC Spindle Servo Unit



(*1) Canon connector MS3102B20-29S is attached to the position coder.

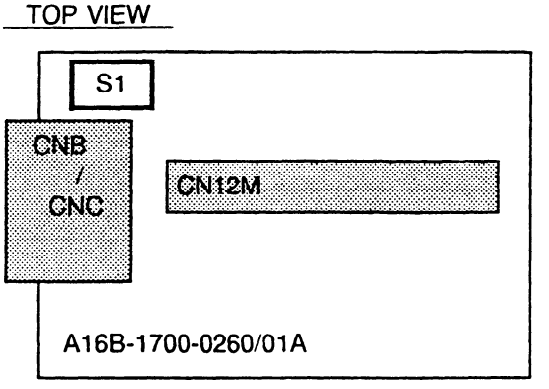
8.2 Cable Sign K15 : Output of Position Coder Signal Input Circuit



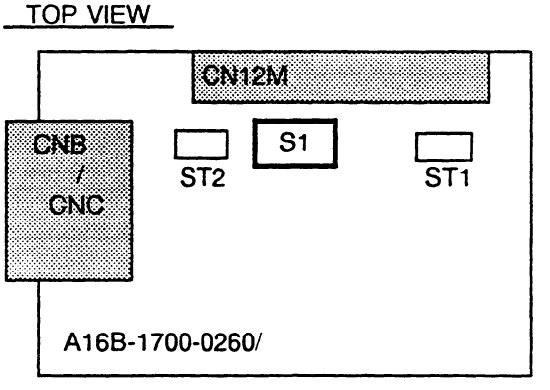
9. JUMPER EXPLANATION

9.1 Jumper Position

9.1.1 P.C.B edition No. 01A



9.1.2 P.C.B edition No. 02A and later



9.2 Setting

Terminal	Content of setting	Position	Setting for use
S1	Shield (SS) of the position coder signal line is connected with GND of P.C.B.	A	A Set position "A" to use
	Shield (SS) of the position coder signal line is not connected with GND of P.C.B.	B	